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ENGINEERING CONSTRUCTION WEEKLY

ENGINEERING NEWS-RECORD

JANUARY 5, 1939

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ENGINEERING NEWS-RECORD

Devoted to Buildings, Sewers, Waterworks, Bridges, Highways, Streets, Dams, Foundations, Earthwork, Flood Control, Public Works, Irrigation, Canals, Railroads

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THE COVER PICTURE shows the studio and office building of the new Columbia Broadcasting Co. development in Hollywood, described on p. 12.

IN THIS ISSUE

IN TECHNICAL ARTICLES this issue is twice as bulky as the usual issue of *Engineering News-Record* in the past. We hope its content is even more than twice as rich.

Such a double dose is to be the rule in the future, but it will come to the reader only at two-week intervals in line with a new publishing plan outlined on p. 10. In this issue will be found articles on buildings, flood control, irrigation, highways, tunnels, bridges, airports, sewage plants, waterworks, earth dams, construction equipment, painting, surveying, contract unit bids, and current labor and materials prices.

And in addition to broader coverage, there is inaugurated a new type of synopsis for each article, designed to improve readability.

THINGS TO COME

● Sewage disposal facilities in the United States—an inventory compiled with the aid of the 48 state sanitary engineers—will be featured in the Jan. 19 issue. This survey is a factual summary of progress and trends, and is the third one to be undertaken by *Engineering News-Record* in the last decade. It shows, for each state, information on the number of people and communities served by sewers and disposal plants, and a detailed tabulation of the major processes of treatment now in use.

● And next week, Jan. 12, readers will receive the first of the biweekly News issues, as further described on p. 10. It will contain News of the Week, Unit Prices, Construction Reports and Bid Proposals but no technical articles.

CONCRETE

GIVES IT MODERN FORM AND STRENGTH

Architectural concrete made with Universal Atlas Cement was used in the Superior Theater, at Superior, Wisconsin. Architect—Perry E. Crosier, of Minneapolis. The contractor—M. E. Greenberg Company, Minneapolis.

Architectural Concrete made with Universal Atlas Cement has become a part of design for beauty in many types of buildings . . . .

THIS Wisconsin moving picture theater is an example of the steadily increasing use of architectural concrete. This reinforced concrete provides beauty as well as strength, durability and fire-safety. It requires little or no maintenance. It is low in first cost, too. Job comparisons usually show a saving in favor of architectural concrete.

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Universal Atlas Cements

THE WEEK'S EVENTS

Highway Funds Apportioned

Funds for highway construction amounting to $135,000,000 were apportioned to the states by the Secretary of Agriculture Dec. 30. Authorized by the federal-aid highway act of 1938, the money will be spent for highway improvement and grade crossing elimination in fiscal year starting July 1, 1939.

Money for improvement of the federal-aid highway system, including extensions through cities, totals $100,000,000. Available for secondary or feeder roads is $15,000,000, and $20,000,000 has been allocated for grade crossings.

All the money will be spent through the state highway departments, but while highway construction funds must be matched by the states, money for grade crossings need not be matched.

The largest single allotment is to Texas, amounting to $8,250,000, while New York is second with $6,909,000. Illinois, the third highest, received $6,580,000. Neck and neck for bottom position are Delaware, New Hampshire, Rhode Island, Vermont, the District of Columbia, and Hawaii, all receiving $658,000. Details of the apportionment are tabulated on page 4.

• • •

Chicago River Diversion Cut for Last Time

Carrying out an order handed down by the U. S. Supreme Court in 1930, the city of Chicago on Dec. 31 reduced its diversion of Lake Michigan water into the Mississippi River watershed from 5,000 sec.-ft. to 1,500 sec.-ft.

When the Supreme Court ordered

(*Continued on page 6*)

SMALL START FOR A BIG JOB

FIRST SHAFT starts down 45 ft. to the level of the future Chicago subway on which work is being started with the aid of a PWA grant. From this 26-ft. diameter auxiliary shaft near Chicago Ave. and Lake St. a drift tunnel will be opened to State St., where driving of the actual subway tunnel will start.

Seven and a half miles of subway will be driven through the business section of the city in this first attempt to modernize Chicago's transit facilities.

First Water Flows In Colorado Aqueduct

Intake pumping plant goes into regular service Jan. 7 and starts filling Gene Basin reservoir

The first water will flow in a section of the Colorado River Aqueduct on Jan. 7 when the Intake pumping plant, having successfully completed preliminary tests, will be put into regular operation.

The Intake plant is the first to be completed of five pumping stations along the aqueduct line. It will take water from the reservoir formed in the Colorado River by Parker Dam, lift it up the canyon wall to a height of 291 ft., and deliver it into a 2-mile tunnel leading to the Gene Basin reservoir.

Ceremonies marking the first regular operation of any part of the aqueduct will be held Jan. 7 at the Gene Basin reservoir.

The entire metropolitan aqueduct system is now about 90 per cent complete, with all major features scheduled for completion by the latter part of 1939. At that time aqueduct water will be delivered into Cajalco Reservoir, the terminal storage basin at the west end of the main aqueduct, and it is expected that water will be distributed to cities in the district before the end of the year.

• • •

Eight Thousand WPA Projects Under Contract

On Jan. 1, the deadline fixed by Congress on which all PWA projects must be under construction, PWA Administrator Ickes reported to the President that 7,853 projects were under contract. These projects, calling for the expenditure of $1,574,770,000 were put under contract in 143 working days. During the four months following passage of the 1938 PWA act, projects were approved at the rate of 2,000 per month, and in the 78 working days allowed for filing applications, applications were

(*Continued on page 2*)

BRIEF NEWS

PROMULGATION by the Douglas Fir Plywood Association of a new commercial standard for plywood, involving uniform grade marking of all panels made by association mills, has led to acceptance by the Federal Housing Administration of the use of plywood for exterior siding for homes. The new grading rules establish grades, with suitable marks, for exterior use, for fine interior wall coverings, for concrete form panels, for interior walls, and for roof sheating.

THE LEAGUE of Oregon Cities has initiated a drive to have $800,000 annually appropriated from gasoline tax funds, now devoted exclusively to state highways, for rebuilding and maintaining city streets. League officials point out that the state highway debt service declined $500,000 this year and that at the same time highway revenues are climbing steadily.

TENANTS began moving last month into Sumner Field homes, PWA-built federal housing project in Minneapolis. Rentals in the 454 dwelling units will range from $19 per month for the two-room units to $30.53 for dwellings containing three bedrooms; rentals include utility charges. Since Minneapolis has no municipal housing authority, the project is being managed by the U.S. Housing Authority.

IN ADDITION to the three engineering firms it has already retained on replacement of the wrecked Falls View Bridge across the Niagara River gorge, the International Bridge Commission has engaged Aymar Embury, 2nd, New York City architect, as consultant on the bridge design. Embury is architect for the Port of New York Authority as well as for the Marine, Hendrick Hudson Parkway, and Triborough bridges. Associated with him as consulting architect will be William L. Sommerville of Toronto, Canada.

A CAFE PROPRIETOR on Kingshighway in St. Louis has been awarded $45,000 damages against the city on the grounds that construction of the new Kingshighway viaduct ruined his business. The viaduct raised the highway 24 ft. and forced customers to use a narrow one-way lane at the side of the span.

A STATE BUILDING CODE has been recommended for Texas by a special committee which was appointed after the London, Texas, school explosion which took the lives of 294 students and teachers last year. The committee suggests creation of a supervising state agency utilizing the services of existing departments. The committee made an independent investigation of the cause of the explosion, its finding coinciding with that of the Bureau of Mines, namely that leaking gas under the floor caused the disaster.

PRESENTATION of a bill raising the Arkansas state tax on gasoline from 6½ cents per gallon to 7 cents is being considered by Governor Bailey. New revenues would be placed in a separate fund to be used solely for construction of hard surfaced roads. Under a 1934 agreement with highway bondholders, none of the state's current highway revenue may be used for construction, 25 per cent being allocated to maintenance and the remainder to debt service.

THE NAME of Western Bridge Co. Ltd., Vancouver subsidiary of Hamilton Bridge Co., has been changed to Hamilton Bridge Western, Ltd. The Hamilton company is one of the contractors on the new Lions Gate bridge at Vancouver, carrying out its share of the project through the Western Bridge Company.

A DOCUMENTARY film, "Millions for Safety," has been produced by the Port of New York Authority. Photographed in the Holland and Lincoln tunnels and on the George Washington bridge, the picture shows how these structures are kept in repair, what methods developed to overcome automobile fumes in the tunnels and how the traffic is handled. The film, one reel long, is being distributed free to organizations in the New York-New Jersey area.

Further brief news items will be found on page 54.

California Public Works Photo

CALIFORNIA ENGINEERS VISIT SHASTA DAM SITE

AFTER seventeen years of study and planning for the Central Valley project, these engineers from the California State Water Department came to Shasta Dam site to watch the start of work on this key structure of their project which is being built across the Sacramento River by the U. S. Bureau of Reclamation.

Left to right, they are: George T. Gunston, Everett N. Bryan, R. L. Jones, H. M. Stafford, A. D. Edmonston, Edward Hyatt, head of the department, T. B. Waddell, and Raymond Matthew.

• • •

Eight Thousand WPA Projects Under Contract

(*Continued from page 1*)

submitted for 12,814 projects totaling $4,000,000,000 in cost.

"The public works administration has demonstrated," the administrator wrote, "that given a competent and experienced organization and a backlog of applications that have been examined and are ready to go, in time of emergency a program of public works can be put into full swing without loss of time or effort. A new reservoir of projects larger than the one which enabled the fast start in June has now been accumulated as the result of the enormous number of worthwhile applications that have been filed under the 1938 act. . ."

New York Leads In Sewage Service

State has largest population served by treatment, but Texas has most plants

New York State leads in the number of people served by sewage treatment plants, according to a nationwide inventory of sewage disposal facilities in the United States being made by *Engineering News-Record* which is now nearing completion. The survey shows that 40,885,000 people, more than half of the urban population of this country, are served by treatment works. In New York treatment facilities are afforded to 5,539,000 people. Illinois is second with 4,822,000.

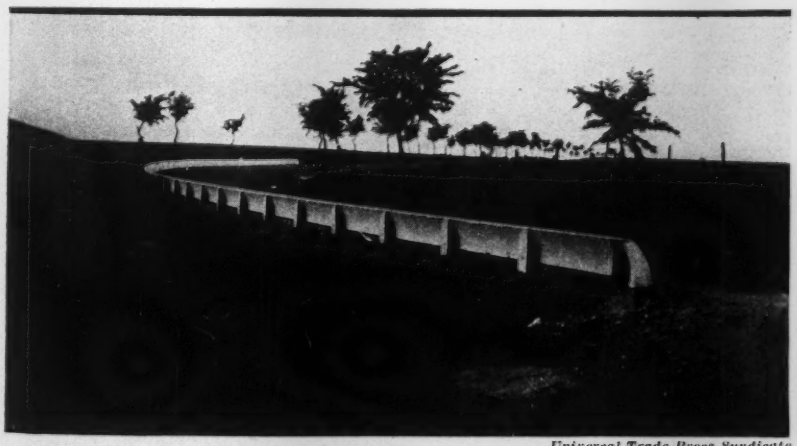
The *Engineering News-Record* inventory shows that there is a 52 per cent gain in the number of people served by disposal works in the three years since the last survey was made. Data compiled from official records of the 48 state sanitary engineers who cooperated in making the survey reveal that 4,662 communities are provided with treatment facilities, 1,200 more than were reported in 1935. Texas has the largest number of communities reporting the use of disposal facilities—445—and New Jersey is second with 263.

The data for each state, which is tabulated under 50 different classifications, includes an analysis of the treatment processes employed in the 4,662 communities. These statistics show, among other things, that the number of activated sludge plants doubled during the last three years.

The complete inventory is scheduled for publication this month.

BURKHOLDER IN NEW JOB

AFTER SIX YEARS in charge of construction on the Colorado River Aqueduct, J. L. Burkholder has resigned his post as assistant general manager of the Metropolitan Water District of Southern California to become chief of the division of engineering in the American Section of the International Boundary Commission with headquarters at El Paso.



Universal Trade Press Syndicate

CONCRETE COATS GUARD RAIL

A DESIGN of highway guard rail consisting of iron castings 2½ in. thick permanently embedded in white cement, has been adopted as standard in Denmark, the country of its origin. It is also being used on highways in Norway, Sweden, Great Britain, Germany and France. Cost of curb protection in Denmark with this type of structure is reported at about $3 per running meter.

Observation of protected curbs during a period in which there were more than 1,000 collisions with the guard rail are said to have resulted in no important damage to cars or barrier.

Los Angeles Engineers Urge Earthquake Study

Creation of seismology institute suggested by Am. Soc. C. E. chapter committee

Formation of an institute for engineering seismological research is urged in a report sent to the executives of the American Society of Civil Engineers by the Los Angeles chapter. The chapter's recommendations are based upon the findings of a committee which it appointed last September, in accordance with suggestions made in a paper presented by R. V. Labarre. The committee consisted of C. J. Derrick, chairman, Garner A. Beckett, and Alfred Neuffer.

The committee points out that "the study of engineering seismology is handicapped by lack of positive leadership, insufficient data, and absence of authoritative interpretation of existing studies." Under these circumstances, the design of structures in earthquake areas has often led to unsafe construction or to unduly expensive protection against earthquakes. The committee recommends that an institute be set up which could maintain an advisory scientific council before which problems in seismology might be placed for study and decision and which could coordinate study and research throughout the country. The institute also would assemble in convenient form literature on the subject and establish a laboratory prepared to supervise tests of materials of construction. In addition, it might establish scholarships in technical schools.

The committee believes that financing of such an institute would not be difficult; money might be secured by public subscription, grants from governmental bodies, and allocations from engineering organizations.

• • •

AGC Approves Standards For Contractors Pumps

The Committee on Endorsements of the Associated General Contractors has approved a set of standards for contractors' pumps submitted by the Contractors Pump Bureau. The Bureau has just joined the Cooperative Construction Bureau of the AGC.

Standard rating plaques similar to those used by mixer manufacturers will be attached to each standard pump. Size standards for self-priming centrifugals range from a 1½", designated as 3M, to an 8", designated 125M. Road pumps have designations such as R-80 and R-150, indicating gal. per min.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

NO EXPLANATION has been given by the U. S. Engineers for the shutdown Dec. 23 of flood control projects along the Merrimack River in New England. They state that the stoppage is temporary and expect work to be resumed early in January. All flood control field work in the Boston district, which includes New Hampshire and Massachusetts east of the Connecticut River, has been halted. Largest project involved is the dam near Franklin Falls, N. H., where 200 men have been laid off.

New Hampshire officials recently have been taking the position that the federal government cannot take over land in the state without state permission, a position which has been opposed by the federal government.

OVERTIME work will be nccessary if the Bureau of Public Roads is to have its report on superhighways ready by Feb. 1, as ordered by Congress, bureau officials announced Jan. 3.

COAL AND RAILROAD interests in Wyoming and Colorado are raising objections to the use of hydro-electric power from the Seminole dam. They are arousing considerable local support. Interior Department officials feel that the work on the project has gone too far to consider its abandonment at this late day. They have signed a contract for the three 20,000 horse-power units that are to be installed, and a transmission line has been built from the dam to Cheyenne. Provision has been made for branch lines to Greeley, Colo. and to Guernsey, Wyo. Officials expect to be able to deliver power early next summer.

WORK IS PROGRESSING on the power house that will use water from the Elephant Butte and Caballo dams. The Bureau of Reclamation is hiring its own labor for this construction, since the job does not lend itself to contract due to the intermittent character of the work. It is necessary to synchronize the work on the power house with the release of water from the Elephant Butte reservoir.

The work on the power house can be completed in eighteen months, but the transmission system must be planned on the basis of load distribution. This cannot be done until it is known what El Paso is going to do. If the city purchases its privately-owned utility El Paso would use practically the entire firm output of the plant—90,000,000 kw.-hrs. annually. The transmission distance to El Paso would be 125 miles.

A LICENSE has been granted by the Federal Power Commission to the San Joaquin Light & Power Corp. for a completed hydro-electric project on the north fork of the San Joaquin River in California. The 39,300 hp. project was built and is operated under a final power permit granted in 1915. The license, for which the company applied in 1935, stipulates that the corporation provide screens to prevent the passage of fish as ordered by the Department of Commerce.

THERE are now more experienced engineers in the government employ than ever before. This is due to the fact that the civil service list of junior engineers has been exhausted for many months, making it necessary to offer junior jobs to those eligible for jobs requiring more experience. Due to the amount of unemployment, large numbers of experienced engineers have accepted such positions.

Efforts now are being made to find ways to promote engineers who have demonstrated their qualifications to bring them into the salary brackets more nearly in line with their actual worth. It will be several months before examinations can be held to build up a new list of junior engineers. Applications for these examinations closed Nov. 14.

THE PROGRAM of cooperation with South American governments recently submitted in the report of the Interdepartmental Committee on Cooperation of the American Republics includes several items of engineering interest. The report recommends continuation of the present encouragement of work on the Inter-American Highway; the amount of such aid would depend on action taken at the forthcoming Pan American Conference.

Five projects costing $53,850 are proposed for the Coast and Geodetic Survey, involving foreign surveys, tidal investigations in South American ports,

APPORTIONMENT OF FEDERAL FUNDS TO THE STATE

State	Regular Federal Aid	Secondary or Feeder Roads	Grade Crossings	Total
Alabama	$2,068,493	$310,274	$393,552	$2,772,319
Arizona	1,423,400	213,510	125,461	1,762,371
Arkansas	1,702,583	255,387	343,731	2,301,701
California	3,793,823	569,073	728,856	5,091,752
Colorado	1,807,919	271,188	251,215	2,330,322
Connecticut	624,021	93,603	167,075	884,699
Delaware	487,500	73,125	97,500	658,125
Florida	1,335,020	200,253	277,471	1,812,744
Georgia	2,507,151	376,073	477,283	3,360,507
Idaho	1,223,119	183,468	161,779	1,568,366
Illinois	4,043,313	606,497	1,030,486	5,680,296
Indiana	2,425,913	363,887	506,736	3,296,536
Iowa	2,542,385	381,358	545,468	3,469,211
Kansas	2,585,837	387,876	504,959	3,478,672
Kentucky	1,824,345	273,652	356,846	2,454,843
Louisiana	1,436,747	215,512	310,856	1,963,115
Maine	873,455	131,018	135,191	1,139,664
Maryland	821,369	123,205	200,663	1,145,237
Massachusetts	1,375,489	206,323	408,286	1,990,098
Michigan	3,012,993	451,949	649,147	4,114,089
Minnesota	2,704,164	405,625	524,721	3,634,510
Mississippi	1,746,261	261,939	310,650	2,318,850
Missouri	2,986,426	447,964	596,184	4,030,574
Montana	2,032,384	304,858	261,252	2,598,494
Nebraska	2,044,283	306,642	347,689	2,698,614
Nevada	1,275,938	191,391	97,500	1,564,829
New Hampshire	487,500	73,125	97,500	658,125
New Jersey	1,321,366	198,205	389,614	1,909,185
New Mexico	1,595,294	239,294	166,957	2,001,545
New York	4,845,924	726,889	1,335,949	6,908,762
North Carolina	2,321,357	348,204	500,977	3,170,538
North Dakota	1,532,167	229,825	309,164	2,071,156
Ohio	3,583,189	537,478	833,853	4,954,520
Oklahoma	2,317,258	347,589	455,041	3,119,888
Oregon	1,638,823	245,823	224,953	2,109,599
Pennsylvania	4,221,088	633,163	1,128,616	5,982,867
Rhode Island	487,500	73,125	97,500	658,125
South Carolina	1,328,214	199,232	293,750	1,821,196
South Dakota	1,610,762	241,614	268,815	2,121,191
Tennessee	2,079,803	311,970	373,187	2,764,960
Texas	6,227,084	934,063	1,088,862	8,250,009
Utah	1,124,731	168,710	129,236	1,422,677
Vermont	487,500	73,125	97,500	658,125
Virginia	1,815,401	272,310	373,906	2,461,617
Washington	1,563,815	234,572	300,063	2,098,450
West Virginia	1,082,034	162,305	260,716	1,505,055
Wisconsin	2,413,315	361,997	486,074	3,261,386
Wyoming	1,249,044	187,357	132,134	1,568,535
Dist. of Col.	487,500	73,125	97,500	658,125
Hawaii	487,500	73,125	97,500	658,125
Puerto Rico	487,500	73,125	150,076	710,701
Adm. & Eng. Reserve	2,500,000	375,000	500,000	3,375,000
TOTAL	$100,000,000	$15,000,000	$20,000,000	$135,000,000

and preparation of a revised hydrographic manual. The committee recommends expenditure of $50,000 a year to expand the work of officers of the U. S. Public Health Service on the Pan American Sanitary Bureau. This would include cooperation toward improvement of water supplies and sewage disposal. Additional personnel would include three sanitary engineers. In addition, it is recommended that twenty post graduate fellowships for South American students of public health, sanitary engineering be established.

• • •

Low Bidder Gets Contract On Pontoon Bridge

The Puget Sound Bridge & Dredging Co., J. H. Pomeroy, and Parker-Schram received a joint contract last week to build the main span of the concrete pontoon bridge across Lake Washington at Seattle. Their low bid of $3,254,000 is for the 6,551-ft. pontoon bridge which includes the 200-ft. draw span.

The Puget Construction Co. received the contract for the eastern approach trestle at $465,000 and the bridge over the channel between Mercer Island and the east shore of Lake Washington at $527,000. Although this company was low bidder on the western approach trestle at $447,000, the contract was awarded to the General Construction Co. of Seattle and the Columbia Construction Co. of Bonneville on their joint bid of $460,000. Contracts for the other units of the project were awarded to those who bid low on the first letting.

Bids on the major units of the project had been rejected Nov. 29 when they exceeded the estimates, and new bids were opened two weeks ago on these units. (*ENR*, Dec. 29, p. 806).

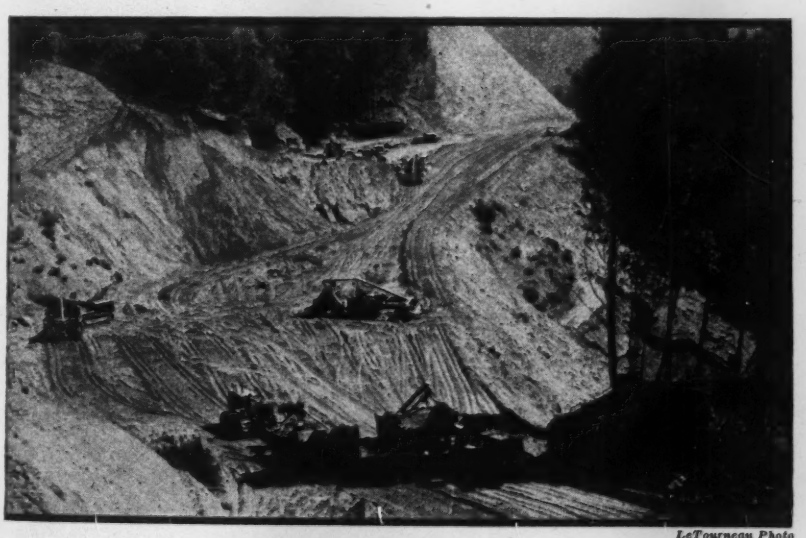
• • •

Base Contracts Approved On Two Housing Jobs

Contract for the general construction of Charles F. Weiler Homes, USHA housing project in Toledo has been awarded to the A. Bentley and Sons Co. on a bid of $1,443,000. On the basis of this bid the net construction cost per dwelling unit will be about $3,903, while the cost per room will be about $741. Plans include 39 brick buildings consisting of two-story row houses and flats.

Also recently approved by USHA is a contract made by the Housing Authorities of Pittsburgh under which Harry Kalison will demolish about 100 substandard dwellings on the site of the Ruch Hill project. Kalison will keep the salvaged material and will pay the authority $905.

Slightly lower dwelling unit costs were achieved in Austin, where contracts on USHA's Chalmers Street development has just been approved. A general construction contract was awarded to Vincent Falbo and Sons at $188,000. The average dwelling unit cost on sixteen buildings in this project will be $2,790 while the cost per room will be about $762.



LeTourneau Photo

MOVING A LOT OF DIRT

HEAVY CUTS AND FILLS are an outstanding feature of the new highway through the Santa Cruz Mountains between Los Gatos and Inspiration Point, in California. Heafey Moore Co. and Frederickson & Watson Construction Co., the contractors, will have to move 2,198,000 cu.yd. of earth in building this 6.3 mi. highway. Material handled is primarily shale and soft sandstone, containing large embedded boulders at some joints.

LABOR NOTES

A DISPUTE concerning jurisdiction over common labor at Juneau, Alaska, which has held up building construction there for more than a month was settled last month when CIO and AFL unions agreed to divide jurisdiction. The AFL body will take over common labor engaged in building construction while other common labor will be recognized as the field of a CIO union.

A BUILDING TRADES department has been formed in the Oregon State Federation of Labor, and a constitutional convention for the new body will be held Jan. 6. Principle objective is unification of wage scales and working conditions throughout the state.

TWELVE oilers and firemen who went on strike last month at St. Louis against the city water department will not be rehired, city director of public utilities Edward E. Wall has announced. He said that the twelve men, who recently joined the operating engineers union, are not being taken back because they are not in good standing with the firemen's union, which is recognized by the city under the terms of the strike settlement. Wall said it had not yet been decided what will be done about seven engineers, also members of the operating engineers union, who are now under suspension.

WORKMEN who were employed by Keystone Builders, Inc., on construction of a bridge over the Rock River for the Chicago Rock Island and Pacific R. R. have entered suit seeking to tie up all operations of the railway in an effort to collect back wages.

EMPLOYMENT of a Milwaukee building inspector by the Racine, Wis., school board has been prevented by the local trades and labor council (*ENR*, Oct. 27, 1938, p. 511). The council threatened to call workmen off a $225,000 school project unless a local man were hired as inspector. The school board said that A. W. Dodge, the man in question, had been hired because of previous lax inspection by Racine men, but Dodge resigned.

THE LOUISVILLE, Ky. director of public works has protested against a scale of prevailing wages set by PWA for work on Louisville streets on the ground that it is too high. The new rate would raise the hourly wage of common laborers from 40 to 50 cents an hour and of steam shovel operators from $1 to $1.25.

Fair Water Supply Is Described

AWWA section meeting hears description of facilities at New York World's Fair grounds

Water supply and distribution facilities of the New York World's Fair were described before the annual winter meeting of the New York Section of the American Waterworks Association on Dec. 29.

Reeves Newson, president of the A.W.W.A., who opened the meeting with a brief report on country-wide conditions in the waterworks field, stated that one of the most hopeful precedents of the year was established by Milwaukee where civil service examinations for waterworks operators waived the requirement that applicants be residents of the city. He also found that air-conditioning demands were not proving the bugaboo which had been anticipated because the use of conservation devices has reduced water requirements as much as 90 per cent.

The principal water lines in the fair grounds were placed to conform to park requirements, rather than those of the fair, said Benjamin Eisner, chief sanitary engineer, New York World's Fair, 1939, Inc. The site of the fair, he explained, will eventually be converted into a city park. Consumption estimates for fair purposes indicated that the average daily total demand will be 7.6 m.g.; the total demand on a maximum day 12 m.g., and the maximum hourly demand about 70 m.g.d.

There are thirteen miles of pipework in the water system, the principal feeders of which are a 48-in. riveted steel line built by the city, and a 20-in. cast iron and steel main built by the fair. These mains flank the exhibit area and are cross-connected with the system. Final selection of material for both temporary and permanent mains was made to minimize total construction and operating costs, said Eisner. The system combines four types of pipe; 13 per cent is cast iron; 3 per cent is ½ in. thick steel; 6 per cent light gage steel, and 78 per cent asbestos-cement pipe.

None of the mains are sufficiently old in service to justify final conclusion as to construction. A few lines have been replaced where major soil movement prevented satisfactory maintenance.

Other speakers on the program were Patrick Quilty, acting chief engineer, Department of Water Supply Gas & Electricity, New York, and Thomas F. Dougherty, chief of the fire department, New York World's Fair, 1939, Inc.

Army Officers Named To WPA Posts

Major Bartley M. Harloe of the Corps of Engineers has been appointed assistant administrator and chief engineer of WPA, succeeding Col. Francis C. Harrington, recently appointed administrator.

Executive assistant to Major Harloe will be Capt. Gordon E. Textor. Captain Textor has been on assignment to the WPA since 1936, and Major Harloe has been with the agency since last July.

Born in 1897, Major Harloe graduated from the U. S. Military Academy in 1917 and served during the war as captain of engineers in this country and France. He later graduated from Rensselaer Polytechnic Institute in civil engineering. He received his majority in May 1936.

Major Harloe has served as U. S. District Engineer at St. Louis, in 1934 and 1935, and was later with WPA as chief regional engineer for eleven western states. In 1937 he enrolled in the Command General Staff School at Fort Leavenworth and returned to WPA last summer as executive assistant to the chief engineer.

Captain Textor was born in 1902 and graduated from the Military Academy in 1924. He received an engineering degree from Cornell in 1928 and served as assistant U. S. Engineer at Vicksburg for a year. He was then for four years engineering instructor at the Military Academy. He became corps area construction officer at Boston in 1933, spent two years in the Panama Canal Zone and was assigned to WPA in 1936, first as assistant to the chief engineer and then as director of the division of project control. He was appointed captain in 1935.

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Chicago River Diversion Cut for Last Time

(*Continued from page* 1)

the city to cut down its diversion progressively to a final 1,500 sec.-ft. on Dec. 31, 1938, the city was treating a major part of its sewage by dilution in the Chicago river. In order to carry out the court's decision it has been necessary to spend about $160,000,000 on treatment and correction facilities.

The present river flow has little value as a diluting agent but is believed sufficient, along with the sewage of the city, to maintain navigation.

Wide World Photo

LANDMARK STARTS FOR JUNK PILE

WORKMEN last month began demolition of the old Sixth Ave. elevated line in New York City. The Harris Structural Steel Co., which bought the structure for $40,000, has 90 days to get the "El" off the streets through the heart of the city which it has occupied for the past 60 years.

H. G. Opdycke Dies, Vibration Expert

Ernest B. Hussey of Seattle helped build the White Pass and Yukon railway in Alaska

Henry G. Opdycke, a civil engineer who specialized in problems of vibration, died Dec. 30 in New York at the age of 68. During construction of New York's first subway, Opdycke advised about questions of vibration and concussion in connection with adjoining properties. He laid out the coordinate system for the construction of Pennsylvania Station and had charge of the like work and of vibration elimination for Grand Central Terminal. He was an organizer of the signal corps of the National Guard of New Jersey, and served in the Spanish-American and World wars, being made a chevalier of the Legion of Honor for his service in the latter.

During construction of New York's Seventh Avenue subway Opdycke directed the underpinning of the Metropolitan Opera House and the New York Produce Exchange building, considered as among the most difficult underpinning jobs on the project. In 1925, as consulting engineer of the Eighth Avenue Association, he developed a plan of submerged by-passing of gas mains during construction. Previously gas mains had been carried on over-head structures during subway construction, resulting in losses to merchants and annoyance to pedestrians.

ERNEST BERTRAND HUSSEY, 73, Seattle civil engineer, died there Dec. 27. After beginning his engineering work in Salem, Mass., he moved to Seattle in 1889. In 1898 he was made general purchasing agent for Close Bros. & Co. of London, in construction of the White Pass & Yukon Railway, establishing Seattle as Pacific Coast headquarters and base of supplies. He was also the engineer on construction of the Walla Walla, Wash., waterworks, and made many land surveys throughout the state of Washington. In 1930 he was appointed chairman of the Seattle Terminal Board, which was organized for the purpose of working toward unification of railroad freight terminals in that city.

GEORGE MAURICE HELLER, 84-year-old Philadelphia bridge designer, died Dec. 28. In 1907, he designed Walnut Lane bridge, a 233-ft. concrete arch span which was the longest of its kind at that time.

ARCHIE B. CREALOCK, consulting engineer of Toronto, died there Dec. 22 at the age of 46. A graduate of the University of Toronto in 1915, Crealock served with the Ontario Highways Department from 1919 to 1929, working up to the position of bridge engineer of the department. In 1929 he formed the consulting firm of Deverall & Crealock, and practiced more recently under his own name. He was registrar of the Ontario Association of Professional Engineers, and secretary of the Dominion Council of Professional Engineers, coordinating body for the various professional associations of Canada.

FRANK E. HEADRICK, 52, Bellingham, Wash., contractor, and Erick Erickson, 47, of Anacortes, Headrick's construction superintendent on a grade school job, died Dec. 23 in a fire which partially destroyed the construction office in which they were sleeping.

H. V. BOGERT, for many years manager of the Seattle chapter of Associated General Contractors of America, died Dec. 25 in San Francisco. He is said to have been one of the first to urge one general agreement between the various construction trades and responsible representatives of contractors.

GEORGE P. WINN, chief engineer of the Chamber of Commerce of the Borough of Queens, New York, died there recently. He was 54 years old. A graduate of Princeton University in 1910, he had been a civil engineer in New York and in Florida. He was a past president of the Queens chapter of the New York Society of Professional Engineers.

JOSEPH P. BARRETT, SR., retired vice-president and treasurer of the Barrett Paving Co., Trenton, N. J., died Dec. 26, at the age of 50. He was formerly with the New Jersey State Highway Department.

THOMAS H. R. JOHNSON, 82, who made the first federal survey of the Indian Territory, now Oklahoma, died at Fort Smith, Ark., Dec. 27. He was at one time city engineer of Fort Smith.

THOMAS W. MAGUIRE, 76, construction engineer who directed the erection of many bridges and paper mills in Canada and the United States, died in South Portland, Maine, Dec. 28.

RAY H. MILLER, 34, a TVA engineer, was drowned near Wayne, Ark., Dec. 26 when his automobile plunged off a bridge into shallow water.

JOHN F. COGAR, 78, construction engineer and general contractor, died Dec. 25 in Brooklyn, N. Y.

ENGINEERING CONSTRUCTION CONTRACTS REPORTED BY ENGINEERING NEWS-RECORD, IN DECEMBER, 1938

Engineering News-Record *reports projects of the following minimum costs: Waterworks, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000.

Five Weeks — Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Mid West	West of Mississippi	Far West	United States Dec. 1938	United States Twelve Months 1938	United States Twelve Months 1937	Canada
Public Works										
Waterworks	5,122	15,252	3,381	2,079	3,879	1,121	30,834	131,209	104,449	264
Sewerage	1,669	7,822	2,070	5,520	5,198	2,742	25,021	136,075	95,294	166
Bridges, public	4,258	7,228	3,026	3,081	5,391	7,316	30,300	126,969	125,230	210
Earthwork and waterways	284	1,538	2,664	1,377	6,269	9,298	21,430	268,306	110,353	485
Streets and roads	870	10,549	11,155	9,104	12,912	5,553	50,143	637,862	414,537	597
Buildings, public	10,298	29,126	19,394	21,819	13,832	8,093	102,562	503,000	333,398	1,536
Unclassified, public	852	5,764	2,339	601	5,878	3,869	19,303	187,754	138,496	5,748
Total, public	23,353	77,279	44,029	43,581	53,359	37,992	279,593	1,991,175	1,321,757	9,004
Federal government (included in above classifications)	3,188	3,924	7,707	3,524	8,003	13,042	39,389	367,784	205,588	.....
Private										
Bridges, private	96	.....	.....	.....	.....	.....	96	7,664	7,859	.....
Buildings, industrial	555	8,460	980	1,107	4,525	691	16,318	152,008	477,298	430
Buildings, commercial	450	21,506	750	3,938	2,000	2,811	31,455	549,746	459,969	865
Unclassified, private	84	695	2,962	5,272	2,775	.....	11,788	91,248	170,740	505
Total private	1,185	30,661	4,692	10,317	9,300	3,502	59,657	800,756	1,115,866	1,800
Total Engineering Construction										
December, 1938 (5 weeks)	24,538	107,940	48,721	53,898	62,659	41,494	339,250	.....	.....	10,804
November, 1938 (4 weeks)	12,310	72,241	29,441	31,335	47,454	24,242	217,023	.....	.....	6,035
December, 1937 (5 weeks)	8,649	67,027	22,875	36,730	39,623	24,129	199,033	.....	.....	10,188
Twelve Months — 1938	148,925	1,053,159	300,399	382,292	497,352	409,804	.....	2,791,931	.....	90,479
Twelve Months — 1937	111,994	1,058,364	242,379	422,723	358,418	243,745	.....	.....	2,437,623	135,508

CONTRACTS AND CAPITAL

ENR CONSTRUCTION VOLUME AND NEW CAPITAL . . . FHA MORTGAGES

(,000 omitted)	December 1937 (5 wks.)	December 1938 (5 wks.)	% Change	Twelve months 1937 (52 wks.)	Twelve months 1938 (52 wks.)	% Change
Total Construction Volume	$199,033	$339,250	+70.0	$2,437,623	$2,791,931	+14.5
Private	67,689	59,657	−12.0	1,115,866	800,756	−28.0
Public	131,344	279,593	+112.0	1,321,757	1,991,175	+51.0
Federal	24,020	39,389	+64.0	205,588	367,784	+79.0
Total New Productive Capital	$91,861	$144,155	+57.0	$2,202,173	$3,704,201	+68.0
Private Investment	91,861	185,667	+102.0	1,047,885	1,134,305	+8.0
Federal (non-federal work)	.....	−41,512†	.....	408,065	1,426,201	+250.0
Federal (federal work)	.....	.....	.....	746,223	1,143,695	+53.0
FHA Mortgages Selected for Appraisal	$32,344	$89,390*	+176.0	$589,469	$1,009,471*	+71.0

*Preliminary. †Adjusted for revisions in PWA allotments.

CONSTRUCTION COSTS . . . WAGE RATES . . . PRICES

	January 1938	January 1939	% Change	Change January to December: Dec. 1937	Jan. 1938	%	Dec. 1938	Jan. 1939	%
ENR Construction Cost Index, 1913 = 100	239.62	234.72	−1.9	241.05	239.62	−0.6	234.89	234.72	−0.1
ENR Building Cost Index, 1913 = 100	198.62	196.24	−1.1	200.45	198.62	−0.9	196.07	196.24	+0.1
ENR 20-CITIES' AVERAGE									
Common Labor	$0.680	$0.682	+0.3	$0.678	$0.680	+0.3	$0.682	$0.682	0
Skilled Labor (Av. 3 Trades)	1.391	1.432	+2.9	1.391	1.391	0	1.427	1.432	+0.4
Bricklayers	1.480	1.514	+2.3	1.480	1.480	0	1.514	1.514	0
Structural Ironworkers	1.442	1.494	+3.6	1.435	1.442	+0.5	1.479	1.494	+1.0
Carpenters	1.251	1.288	+3.0	1.257	1.251	−0.5	1.288	1.288	0
Cement, per bbl	$2.53	$2.57	+1.6	$2.53	$2.53	0	$2.56	$2.57	+0.4
Reinforcing Steel, cwt	2.91	2.48	−14.8	2.91	2.91	0	2.48	2.48	0
Struct. Steel Shapes, Pitts.	2.25	2.10	−6.7	2.25	2.25	0	2.10	2.10	0
Sand, per ton	1.24	1.24	0	1.23	1.24	+0.8	1.23	1.24	+0.8
Lumber, 2x4 Fir, per M ft.	34.74	32.47	−6.5	36.02	34.74	−3.6	32.67	32.47	−0.6
Lumber, 2x4 Pine, per M ft.	29.24	29.09	−0.5	31.35	29.24	−6.7	29.21	29.09	−0.4
Brick, common, per M	14.16	14.03	−0.9	14.11	14.16	+0.4	13.86	14.03	+1.2
Ready-Mixed Concrete, c.y.	7.39	7.17	−3.0	7.42	7.39	−0.4	7.14	7.17	+0.4
Struct. Clay Tile, 3x12x12	72.71	74.48	+2.4	72.89	72.71	−0.2	74.48	74.48	0
Paving, Asphalt, cars, ton	16.98	13.92	−18.1	16.99	16.98	−0.1	14.16	13.92	−1.7

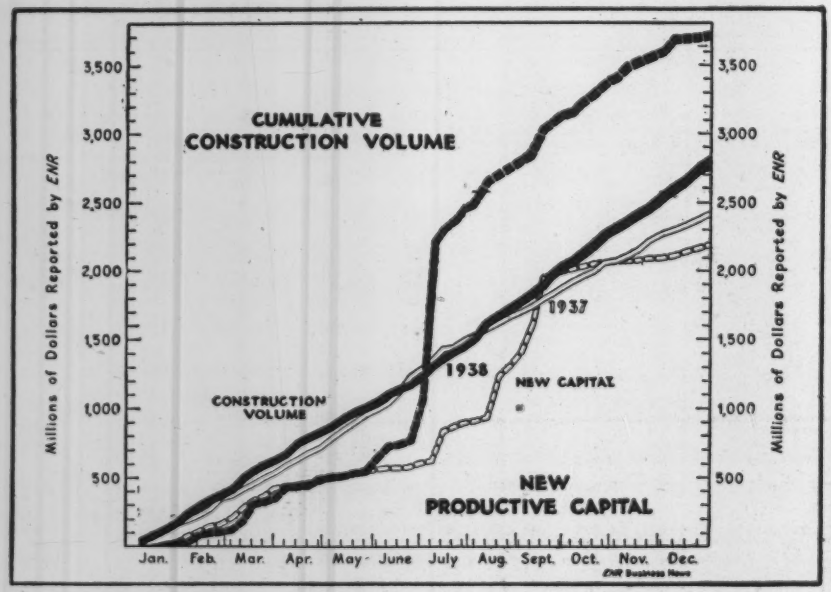
MATERIAL SHIPMENTS . . . BUILDING PERMITS

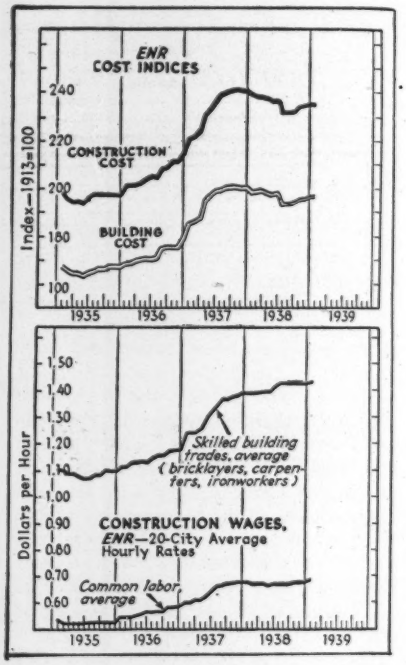
	December 1937	December 1938	% Change	Nov. 1938	% Change Nov.-Dec.
Lumber (% 1929 wk. av.) N.L.M.A.	42.0	58.3	+13.9	62.8	−7.1
Steel (% operating capacity) A.I.S.I.	25.4	53.7	+111.4	60.6	−11.4

	November 1937	November 1938	% Change	Eleven Months 1937	Eleven Months 1938	% Change
Fabricated Structural Steel (A.I.S.C.) tons	130,156	94,979	−27.1	1,552,174	1,039,892	−33.1
Cement, thous. bbl. (USBofM)	8,188	8,573	+4.7	109,217	100,243	−8.4
Building Permits, Dun & Bradstreet (,000 omitted)	$69,589	$89,648	+28.8	$1,012,171	$1,057,950	+4.5

RENT INDEX . . . EMPLOYMENT

	November 1937	November 1938	% Change	Oct. 1938	% Change Oct.-Nov.
Rent (Housing), N.I.C.B.	89.1	86.4	−3.1	86.6	−0.2
Trade Unions, % Employed, A.F.L.	86.0	84.0	−2.2	85.0	−1.1
Building Trades, % Employed, A.F.L.	72.0	68.0	−5.6	68.0	0





CONTRACTS

(Thousands of dollars)

	Week Ending Jan. 6 1938	Dec. 29 1938	Jan. 5 1939
Federal	$2,466	$3,559	$7,503
State & Municipal	28,400	44,007	68,415
Total public	$30,866	$47,566	$75,918
Total private	18,312	11,944	11,077
TOTALS	$49,178	$59,510	$86,995
Cumulative 1939 (1 week)			$86,995
1938 (1 week)			$49,178

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1938 1 Wk.	1939 1 Wk.
NON-FEDERAL	$6,481	$24,657
Corporate securities	1,800	5,135
State & Mun. bonds	4,681	11,484
R.E.A. loans	.....	8,038
FEDERAL	.....	.....
TOTAL CAPITAL	$6,481	$24,657

FHA MORTGAGES

	Week Ending Dec. 31 1937	Dec. 24 1938	Dec. 31 1938
Selected for appraisal	$5,844	$18,298	$12,500*
Cumulative 1938 (52 weeks)			$1,009,471*
1937 (52 weeks)			$589,469

* Subject to revision.

ENR INDEX NUMBERS

Base = 100	Construction Cost 1913	1926	Building Cost '13	'26	Volume '13	'26
Jan., 1939	234.72	112.83	196.24	106.08	...	...
Dec., 1938	234.89	112.87	196.07	105.99	249	109
Nov., 1938	234.40	112.69	195.58	105.71	199	87
Jan., 1938	239.62	114.90	198.62	107.30	172	75
Dec., 1937	241.05	115.65	200.45	108.50	143	63
1938 (Av.)	235.86	113.34	196.83	106.40	197	86
1937 (Av.)	234.71	112.66	196.15	106.07	172	75
1936 (Av.)	206.42	99.15	172.18	93.14	185	81
1935 (Av.)	196.44	94.43	165.76	89.65	134	59

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

A Christmas Greeting

Serving grim notice that a series of articles on mosquito control engineering published in *Engineering News-Record* in 1936 has not been forgotten in some quarters, a glass tube containing a vicious-looking mosquito dropped out of a Christmas package addressed to this office.

The accompanying card said:

"A merry Christmas now while I am hibernating but come the 4th of July I'll sweep boldly down and alight with the caress of a branding iron. Cordially and with spirit, Madam *Anopheles*."

Authorities have traced the package to Memphis, Tenn. It is further known that Major J. A. Le Prince—the sanitary engineer who did such notable mosquito extermination work on the Panama Canal—harbors a lively collection of malaria mosquitoes in the U. S. Public Health Service laboratory at Memphis. So!

"Chicago Drives Ahead"

Sir: The editorial, "Chicago Drives Ahead", which appeared in the *Engineering News-Record* issue of Dec. 8 has just come to my attention, and I want you to know that this splendid editorial is deeply appreciated.

Its fairness and constructiveness are decidedly of advantage to Chicago in general.

EDWARD J. KELLY
Mayor, City of Chicago, Dec. 20, 1938

Credit for the WPA

Sir: In the last two issues of the *Engineering News-Record*, Dec. 1, p. 686, and Dec. 8, p. 725, there appeared articles concerning the new University of Minnesota hydraulic laboratory at Minneapolis, which was erected under a Works Progress Administration project.

The first of these articles describes the laboratory as a PWA project, while the second omits any reference to the builder. Inasmuch as the hydraulic laboratory is one of the outstanding WPA projects in Minnesota, we feel rather keenly omission of credit to the Works Progress Administration for this project. I know this omission was not intentional.

A. W. VON STRUVE,
Chief, Data Subdivision, WPA, Washington, D. C., Dec. 19, 1938

Earth Roads

Sir: The forthright manner in which you published Mr. George E. Martin's letter (*ENR*, p. 779, December 22, 1938) will likely do a good deal toward dispelling the misleading impression created in *News-Record* editorial of December 8 under the caption, "Rise of the Earth Road". It implied that stabilized soil roads "are fully as complex and costly as those required to lay a concrete slab pavement". It is true there was a saving clause limiting the statement to "Some developments—".

The cases referred to must have been exceptional, for I know of no costs for soil stabilization which approximate those of concrete slab pavement. Further, Virginia Department of Highways' engineers (I am told) reported at the very meeting discussed in your editorial that the cost of 6 in. asphalt soil stabilization on Route No. 168 in New Kent County, Virginia, was 37¢ per sq.yd. Furthermore, that project was only 4,000-odd feet long and contained approximately 6 per cent (by weight) cut-back asphalt, MC-2. A longer project would probably have cost even less. If this cost was actually reported, as I am told, it seems to me that it should properly have been referred to as a qualifying statement in the editorial which may have been misleading concerning what was actually reported at the meeting discussed in the editorial.

I feel sure that you did not wish to "make a case" for any particular type of pavement, nor do I believe that you intentionally wished to be misleading. You implied, however, that matter of cost was one of the unanswered questions that lie in this type of construction. Therefore, I believe that you will wish to develop true facts concerning the Virginia project referred to and possibly others of equally low cost, giving equal editorial space to those particular answers.

W. R. MACATEE
The Asphalt Institute, Cincinnati, Dec. 24, 1938

Reciprocal Buying

Sir: Under the attack on business by the present administration we manufacturers like to feel that we are martyrs. We know the attack is unjustifiable, in general. Government, however, has uncovered some abuses which are real enough to justify action. One of these is reciprocal buying. This exploded theory is continued only because of its age, not because anyone in industry finds it a satisfactory method of placing business.

Industry, at great expense, sets up a purchasing department, an inspection department and an engineering department, to produce material of proper price and quality. After having done this they put in a reciprocal relations department which overrides the decisions of the buyer, the inspector and the engineer and places business merely because of the suppliers returning the favor, which results in frequent strained industrial relations, since no one can buy in a volume to satisfy the reciprocator. Not only that, but the distribution is never fair from the seller's point of view.

Reciprocal buying results in higher prices since the reciprocator cannot get the best price available. It results in lower quality since the reciprocator cannot insist on quality. It results in lack of standardization which enormously increases cost of upkeep.

The situation gives politicians further excuse to talk about inefficient management of American business, and how necessary it is for government to guide, direct and protect industry. The worst of it is that in this case the government would have a perfectly clear case to prove its point. No one could take the untenable position that reciprocal buying is anything but asinine and wasteful. However, under governmental regulation, a waste will be turned into regimentation from which industry perhaps can never recover.

J. F. LINCOLN
Lincoln Electric Co., Cleveland, Ohio.

ENGINEERING NEWS-RECORD

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Editorial Offices at 330 West 42nd Street, New York

JANUARY 5, 1939

ENGINEERING NEWS-RECORD is a consolidation of Engineering News and Engineering Record, effected in 1917. The Contractor was consolidated with Engineering News Record in 1918. Engineering News was founded in 1874 as The Engineer and Surveyor, which title subsequently became The Engineer, Architect and Surveyor, Engineering News and American Railway Journal and finally Engineering News. Engineering Record was established in 1877 as The Plumber and Sanitary Engineer. Subsequently it became The Sanitary Engineer, Engineering and Building Record, and, finally, Engineering Record. All rights to the above titles are reserved.

To Our Readers

With this issue Engineering News-Record appears in rearranged and improved form, as announced last week. The new form has been planned to give the reader better service by affording him more technical information and better news reports in less reading time.

Back of the change is a careful study of reading habits and reader requirements, which showed that the time factor in the engineer's working life has been profoundly affected by the day's many demands. It indicated that efficient reading must be economical reading.

For a long time past the editors have realized that every man's time budget is daily becoming more crowded. While continuing their consistent efforts to keep the paper in step with technical progress they saw that more thoroughgoing modernization must be kept in view. The reader study provided the data for this modernization.

Many readers reported that they were not able to get through reading the weekly paper; we concluded that articles should be written for faster reading and should remain in the reader's hands for a fortnight. Road men wanted more road articles, concrete men more concrete articles, and we concluded that more matter should be provided, in more concentrated form. But also, news reports were demanded every week; a weekly News Issue was therefore imperative.

The rearranged Engineering News-Record has been designed accordingly. It concentrates an increased number of articles in biweekly issues, which contain also a broadened news section and all other current information. Further, it provides weekly news service by a news issue published intermediate between the biweekly technical issues, and containing news, construction reports, invitations to bidders, and contract unit prices. Material prices will appear in the first issue of the month as heretofore.

In brief, full service, convenience and readability are the objectives of the new form. As it grew out of experience, we believe that it will prove of practical service.

—The Editors

Keep the Money at Home

As PART of the present war hysteria the Nicaraguan Canal is again being revived. The argument is the threadbare one that two canals are better than one and give much greater assurance that an enemy could not bottle up a fleet in the Atlantic or the Pacific. According to the naval strategists, as we follow their argument, it would be fairly easy for an enemy to put the Panama Canal out of commission, but apparently it would not be so easy to do the same to the Nicaraguan Canal, although to the layman it would seem to be no harder job. So we are to be asked to spend $725,000,000 on construction of a second canal at a time when the Navy Department admits that it cannot protect even one canal against sabotage or air attack. The proposal does not seem to make sense. Saner procedure would appear to be to spend a much smaller sum on duplicate locks at Panama, according to plans now being made, thus greatly reducing the possibility of that canal being put out of service. The hundreds of millions saved could be spent on more productive public works at home.

Debris Dams Vindicated

DEBRIS DAMS to catch and retain the wash carried down with floods were the subject of active discussion some years ago when first proposed for the mountains streams of Southern California. The past year's test leaves no question about their effectiveness; measurements made after the storm of last March, reported in this issue, show that the disaster of New Year's day, 1934, in the Montrose-La Crescenta area would have been repeated had it not been for the check dams above that district. Boulders, gravel and soil to a volume of 541,000 cu. yd. were held harmless in the several small catchment basins above the town instead of carrying death and destruction in their passage through the city streets. These basins must be emptied to be made effective again, but that cost is insignificant compared to the damage that the same debris would have done in the towns. The basins have justified themselves as highly profitable.

Lost Storage Capacity

IN CONTRAST with the catchment of debris in basins built for that purpose, the entrance of wash into reservoirs designed to store flood waters may result in serious loss of capacity. Areas denuded of tree and brush growth by fire, especially steep mountain areas, are apt to be scoured clean by floods, and thus large quantities of debris are carried down into storage reservoirs. How serious the

effect can be is shown by the fact that even the unusually large San Gabriel No. 1 reservoir finds one-tenth of its capacity permanently gone as the result of a single storm. The relatively small quantity of debris that lodges in debris basins can be dug out and trucked away, but such methods are not easily applied to large flood storage reservoirs. Raising the existing dam or finding a new dam site is rarely practicable. In consequence the silt and debris menace to mountain storage reservoirs cannot long continue to be ignored. Impairment of storage service would bring ruin of such magnitude, that, unless means can be found to prevent the filling of such reservoirs, removal methods will have to be developed regardless of cost.

South Penn Experiment

PENNSYLVANIA has begun construction of the first important limited-access highway to be built in the country, a toll road reaching from the outskirts of Pittsburgh to the outskirts of Harrisburg. As the first of such roads it should serve to bring an end to much theorizing concerning limited-access superhighways and toll roads. Basic facts soon will be available on the service value of such roads. The South Penn highway will provide better grades, alignment and driving conditions than is found on either of the principal east-west highways that now wind their way over the mountain ridges of western Pennsylvania. Tolls have been set high enough for the expected traffic to amortize its high cost—$370,000 a mile. The next two or three years should produce badly needed information on the amount and character of traffic that is willing to pay a substantial charge for special highway service.

Crossing Problems

AN IMMEDIATE PROBLEM of the engineers building the South Penn highway is how to provide for the nearly 200 minor local and farm roads that cross the 161-mile route. Major crossings obviously call for extensive grade-separation structures with exits and access roads where tolls can be collected, but minor roads must either be carried over or under the highway or must be closed through agreement with local authorities. The total cost of the many that must be separated, even by simple structures, runs to large figures, even though the South Penn highway runs through a sparsely settled region. As a similar road in a thickly settled region would have to deal with a much larger number of separated crossings, it is plain that crossings become a major expense in planning for superhighways in regions where they are most needed.

Diversion—Now Filters

ON SCHEDULE the Chicago River controlling works were put into operation on midnight of the last day of 1938 to prevent reversal of flow during intense rainfall when sewage intercepters are overtaxed and discharge maximum flow into the river. In accordance with the ruling of the U. S. Supreme Court the Sanitary District has cut the diversion of lake water from 5,000 sec.-ft. to 1,500 sec. ft. This lessening the head of water that determines inflow from the lake would permit frequent outflow of heavily polluted waters, with grave danger to the city's water supply intakes, unless control works were provided.

The District has spent $160,000,000 on sewage disposal plants and intercepters since the Court in 1930 required progressive reduction from the 8,500 sec.-ft. diversion of that date to the ultimate 1,500. Coincident with the successive reductions has been a continuous drive to complete the disposal plants so as to turn into the Illinois Waterway a treated effluent of high degree of purification. This year will see the district collecting and treating 99 per cent of the sewage of its areas—truly a remarkable record of achievement. But sewage treatment alone cannot safeguard the purity of the lake waters.

The controlling works now placed in service will prevent pollution of the city's water supply from the Chicago River, but they do nothing toward preventing pollution from the Calumet. The reductions in diversions will cut the westward flow at this point from 750 sec.-ft. to 150 sec.-ft., which is not enough to give security against reversals. It is the Calumet reversals, which henceforth will occur more often, that in the past have polluted the water at the southerly cribs of the waterworks system almost beyond possibility of sterilization and have given the prime impetus to construction of the South Side filter plant for which plans are ready.

Largest in the world, this 400-m.g.h. plant will be only one of three units to serve the city, the three costing nearly $100,000,000. Its significance and urgency has been dwarfed, however, by the subway project just put under construction. Yet, like the subway, the filter project requires speedy scheduling, since the PWA grant requires completion by next October, while the subway has until the following July. But in addition a greatly increased urgency affect the filter project because of the sharp reduction in lake diversion just accomplished; the risk of gastro-enteritis epidemics is now multiplied to grave degree. Chicago has cared for its sewage, but it has been slow to strengthen its primary defense—filters. Nothing should be permitted to halt their early completion.

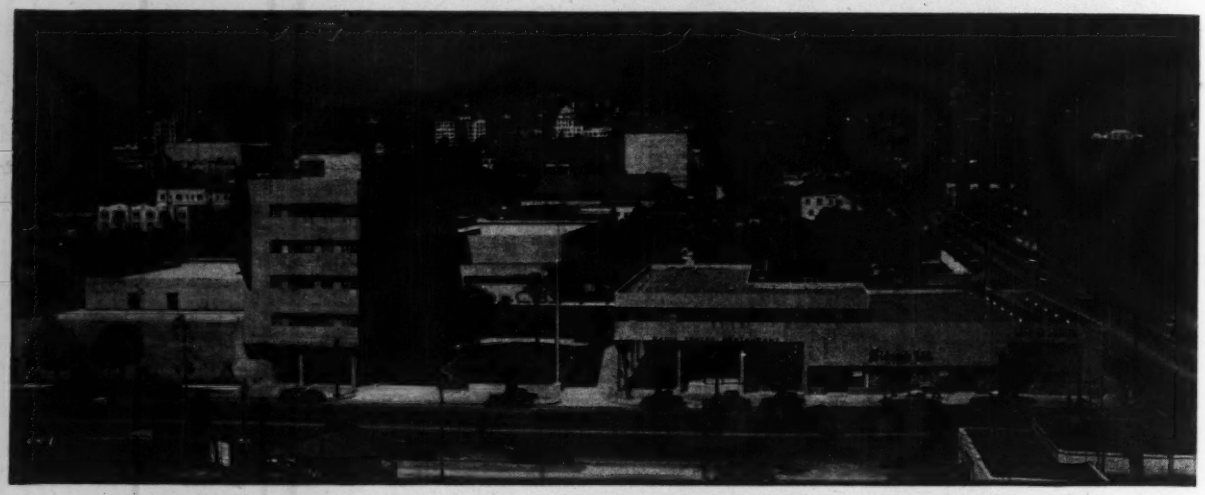


FIG. 1. RADIO CENTER IN HOLLYWOOD GROUPS BUSINESS BUILDINGS WITH BROADCASTING STUDIOS

Design for Broadcasting

Contents in Brief—Group of reinforced-concrete buildings built in Hollywood by Columbia Broadcasting Co. is noteworthy for its strikingly modern architectural concept, its structural design to resist lateral forces, its planning of room and corridor layout, its acoustical treatment to meet the special requirements of radio and its block-square site.

Because of flexible first-story columns in a five-story building, this structure is made to "lean" on an adjacent solid-wall, one-story building for its earthquake resistance. Buildings are designed for a force of 0.8 gravity. Inclined walls are an acoustical feature of the studios.

The article indicates how radio demands have influenced building planning and design and illustrates how, by means of ingenuity, earthquake resistance may be imparted to buildings of unusual layout.

NOTABLE ADVANCE in facilities for radio broadcasting is recorded by the new group of buildings built by the Columbia Broadcasting Co., for its station KNX in Hollywood. Occupying most of an entire block, the buildings, all of reinforced concrete, are divided into two groups, enclosing three sides of a landscaped patio facing Sunset Blvd. as shown in Fig. 2.

In one group are the business buildings (actually a single two-story structure with several dividing walls) built to protect the property from encroachment by undesirable neighbors and to provide room for expansion. In the other group are three buildings—a five-story office building, a studio unit, partly one and partly two stories, and a studio-theatre with roof at the fourth story level of the office building. It is this office-studio group that is particularly interesting. Specifically, space layout, earthquake design and acoustical planning are noteworthy.

Space layout

The plot and first floor plan are shown in Fig. 2, the second floor plan in Fig. 4. Space planning was dictated completely by broadcasting requirements and one of the fundamental problems was to provide for efficient circulation of traffic within the buildings, particularly on the first floor where visitors, entertainers, office employees and technicians have to be accommodated.

As will be noted from Fig. 2, the first floor of the office building is given over to a lobby which merges with the lobby of the studio theatre and connects with a wide central corridor in the studio wing. Visitors entering the office building from Sunset Blvd. are in a glass inclosed arcade, to the right of which is a landscaped patio. Immediately ahead, at the point where the studio corridor turns off to the left, is the information booth and beyond, in the corner where the theatre and office building join, is the master control room, glass inclosed so that all operations are in full view.

Such a "show window" location for the master control room is an innovation and was adopted to impress visitors with the fact that they are in a building devoted exclusively to broadcasting.

In the studio wing, visitors enter the studios from the central corridor, but for broadcasting personnel rear entrances were desirable. Accordingly, a staff corridor completely encircles the studio wing so that visitor and employee circulation do not cross at any point.

Earthquake provisions

The structural design necessary to convert this space planning into an actual building proved to be both in-

teresting and difficult. Earthquake forces equal to 0.8*g* had to be resisted, with a factor of safety of two or more. Each of the three reinforced concrete buildings—office, studio wing and theatre—had to be of slightly different construction and considerably different mass, therefore, of different fundamental period. An architectural feature was the use of free-standing first story columns in the south and east fronts of the office building, the first story walls being set back from the building line as shown in Fig. 3.

Briefly described, the five-story office building is of tier type; the studio building of bearing-wall type, virtually a windowless box; and the theatre-studio, also of bearing-wall type. An original design contemplated each of the three buildings as a separate unit structurally. Considering vertical loads alone, such a scheme was admissible, but under lateral forces as exerted by an earthquake, the office building, by itself, would be subject to torsion because of the flexible columns in two sides and the rigid concrete walls in the other two sides.

The exceptional rigidity available in the adjacent windowless concrete box that formed the studio wing offered a solution. By combining this building with the office building, as suggested by the architectural design, a stable combination structure resulted. As a matter of fact, with such a scheme the free standing and slender columns sought by the design are held to be desirable for they form a "hinge" that detaches the office building from the ground in so far as lateral forces are concerned and thereby throw all earthquake forces into the rigid walls and roofs of the studio wing.

The studio unit is on spread footings, while the office building foundation is an inverted flat slab mat, generally 18 in. thick but increased at the column locations to as much as 36 in. Where the foundations of the studio wing and office building adjoin at different levels, a sloped connecting footing is used to obviate "hammering" under lateral forces and to eliminate sudden changes in concrete section which it is believed will be an aid in reducing shrinkage cracks.

One more innovation was made in order to take care of the twisting action that would be set up in the office building by virtue of the difference in rigidity of its walls. Since, the rear two-thirds of the studio wing roof connects with the office building at the third floor level while the front third of the roof adjoins the second floor, this front portion of the office building, unsupported above the second floor, would act as a whip under lateral loads. This danger is eliminated by the installation of a flying buttress or inclined strut opposite the second column in from the front and connecting the third floor of the office building to the studio roof at the second floor level. This strut (Section AA, Fig. 4) gives the same support at the front of the office building that the studio roof provides at the rear. A solid one-way concrete slab (6½ in. thick) is substituted for pan construction in the studio roof and a two-way slab (7 in. thick) in the second floor of the office building adjacent to this strut to distribute the earthquake forces.

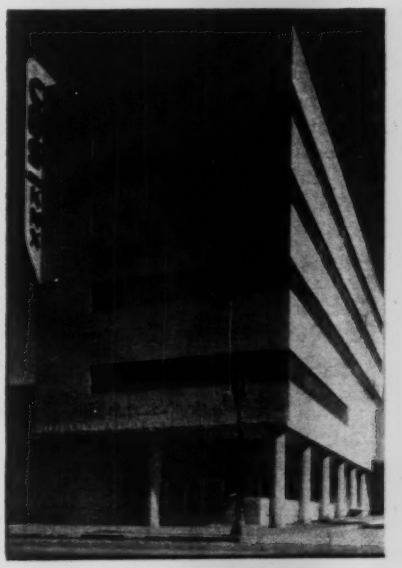


Fig. 3. Office building of broadcasting group is notable for free-standing columns in its first story.

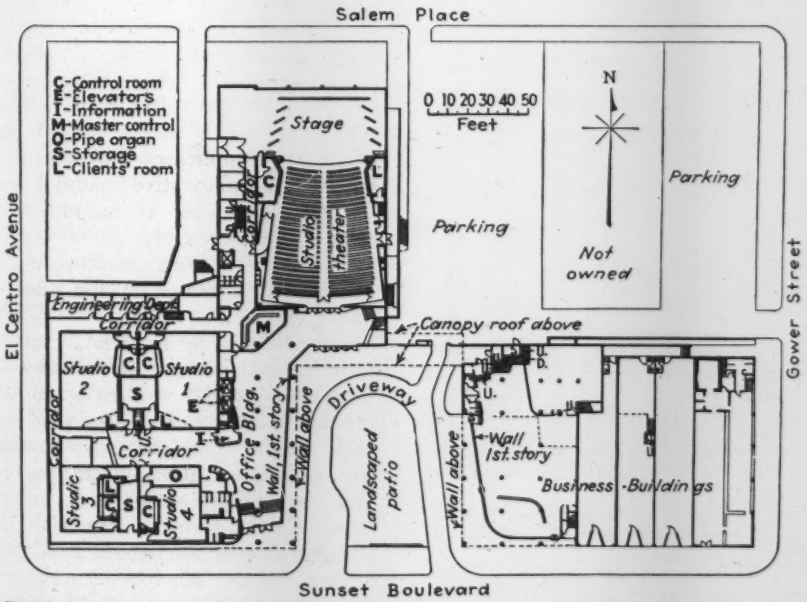


Fig. 2. Plan of Columbia Square in Hollywood. The studio theatre, seating 1050 persons, is in a building by itself. Two small studios are on the second floor of the office building while the larger ones are in the one-story wing on the corner of the block. Note corridor encircling studios which provides back entrances.

Since earthquake forces are brought into the office building at the third floor, high moments and shears occur at this level. To resist and distribute them to the bents, the third floor is made a solid two-way slab 7 in. thick, supported by beams at four sides in each panel. The pan construction of the other floors in the office building is also used as a distributing diaphragm, although no account is taken of the 10 in. deep ribs, and only the 2½-in. slab is so utilized. However, the rib spacing is limited to twenty-four times the slab thickness as an additional item of strength.

The columns of the bents are 25 in. in diameter in the first story and of T-shape above. The T-columns (with the stems turned outward) pro-

vide space for utility pipes and in addition give a very efficient section for bending on their strong axis. Columns of T section also slightly reduce the beam spans over those required with square section columns; for example, the head of the T upon which beams rest is 18 in. from the face of the wall. Reinforcement in walls consists of ⅝-in. dia. rods on 12 in. centers both ways. Walls 8 in. thick or over utilize such reinforcing in each face, while in 6 in. walls a single line of steel in the center of the wall is used.

From the beginning of the design work it was considered imperative to make the studio-theatre a completely separate unit so that it could vibrate in its own fundamental period without hindrance from the office building. Accordingly, an 8-in. wide joint, completely separates the two buildings. At exterior walls this joint is closed by a stainless steel plate. In deference to earthquake requirements, the balcony is not attached to the studio-theatre structure. Near the front end it is supported on a heavy concrete girder 6 ft. deep spanning between columns resting on separate footings inside of the theatre walls. Had the balcony been attached to the side walls over the rear half of the building, an unusual rigidity would have been given to this part of the structure compared with that obtaining in the front half; rigidity in the front half could only have been increased by heavier construction of the walls and proscenium girder, already 12 ft. deep, which would have been much more costly than the plan of a separate balcony that was followed.

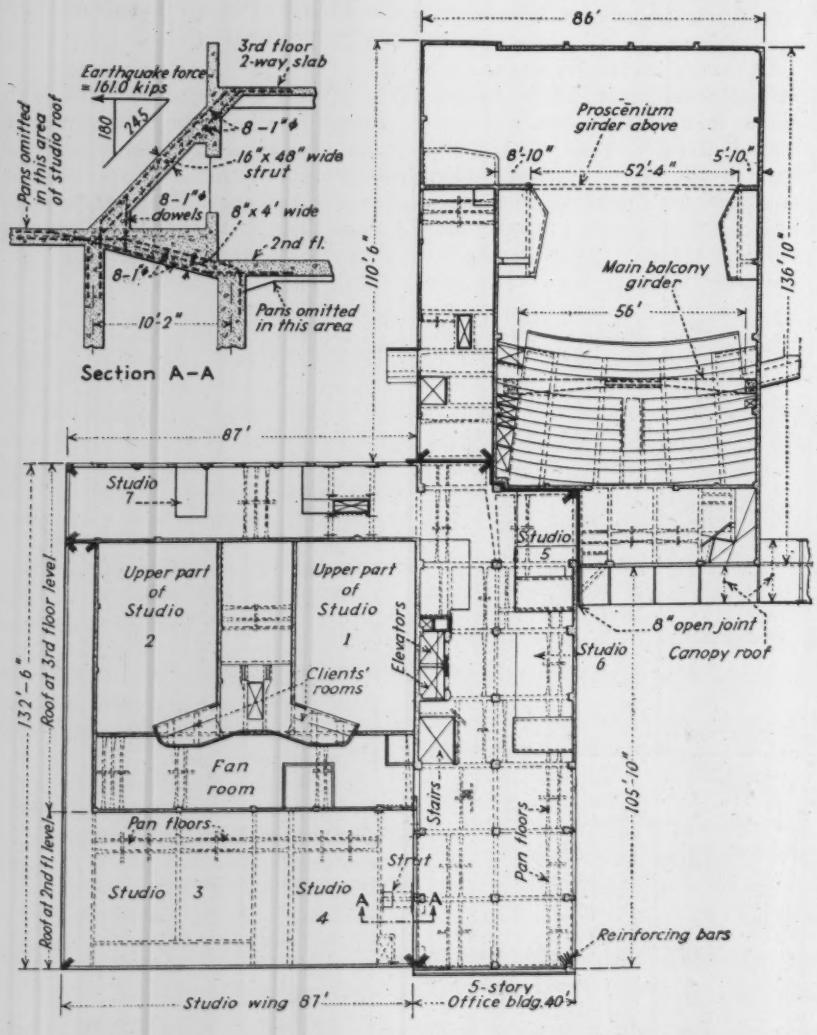


Fig. 4. Structural framing plan at second floor level showing flying buttress strut, floor construction, separation joint between office and studio-theatre and location of proscenium and balcony girders in studio theatre.

Acoustical features

In so far as other design elements of the office and studio wing are concerned, those pertaining to or influenced by acoustical requirements are most interesting. The acoustical design was predicated on several objectives—to reduce studio noise, to eliminate multiple echoes between parallel walls and to control reverberation and room resonance. The objectives were attained: (1) by the separation of the floor, walls and ceiling of each studio from the structural frame of the building by means of flexible supports, clips and hangers; (2) by the use of double door entrances to all studios; (3) by the isolation of all rotating or vibrating machinery through flexible supports; (4) by the use of a honeycomb structure of absorptive cells in all ventilating ducts; (5) by the use of acoustical plaster in all corridors, lobbies, and public spaces that are in the vicinity of the studios, and (6) by the use of non-parallel (inclined) walls in the studios.

Inclined walls

The feature of greatest novelty is the use of inclined walls (Fig. 6) to minimize the effect of "room flutter," that is, the repeated reflections between parallel walls of such sounds as hand clapping, pistol shots, etc. By this device (the walls being sloped inward from the base 1 ft. in 10 ft.), supplemented by the distribution of absorptive material on the surfaces of the room, multiple echoes are effectively damped out and a more uniform distribution of intensity is obtained in the microphone end of the room.

The absorptive material (perforated cement-asbestos board backed with rock wool) is distributed to provide a live and a dead end in each studio. The end wall at the live end is of hard plaster as is also the ceiling in this end; otherwise, the absorptive material is distributed over the remainder of the ceiling and the other three walls in such a way that the rate of sound decay is constant in each of the three principal directions. The absorptive material is staggered in a checker-

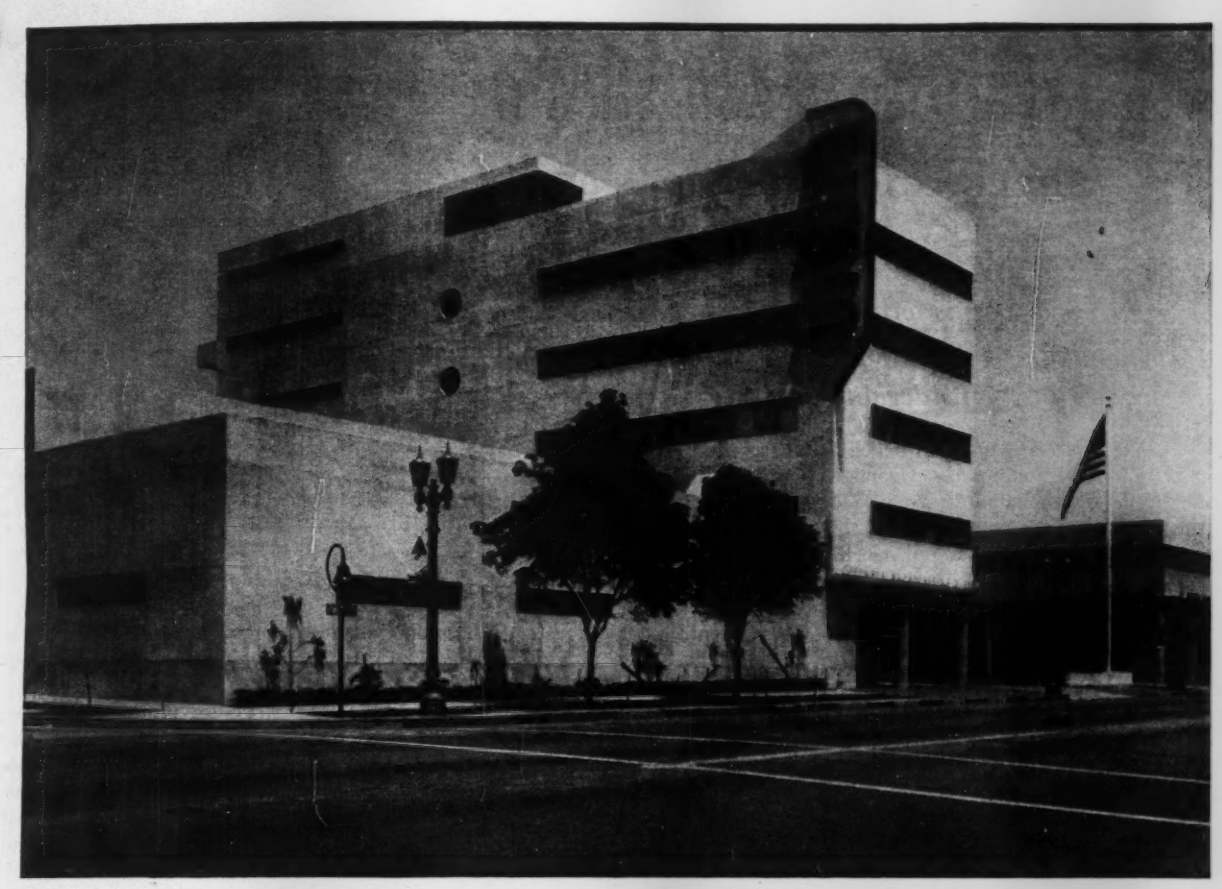


Fig. 5. In an earthquake the office building will "lean" on the low solid-wall studio building, its free-standing first story columns not being designed to resist the lateral loads resulting from seismic vibrations.

board fashion, which not only facilitates the proper distribution over the ceiling and three wall surfaces, but also is said to contribute to the maintenance of diffuse sound throughout the studio, and to increase the effective absorption at low frequencies.

In the large studio, with a seating capacity of 1,050, which is virtually a theatre, the control of reverberation is accomplished by the use of (1) acoustical plaster applied to rough and scratch coats of hard plaster on metal lath and channel irons, and (2) heavily upholstered chairs. The chairs, with both seats and backs upholstered, are said to be so sound absorptive that the reverberation is almost independent of the size of the audience present.

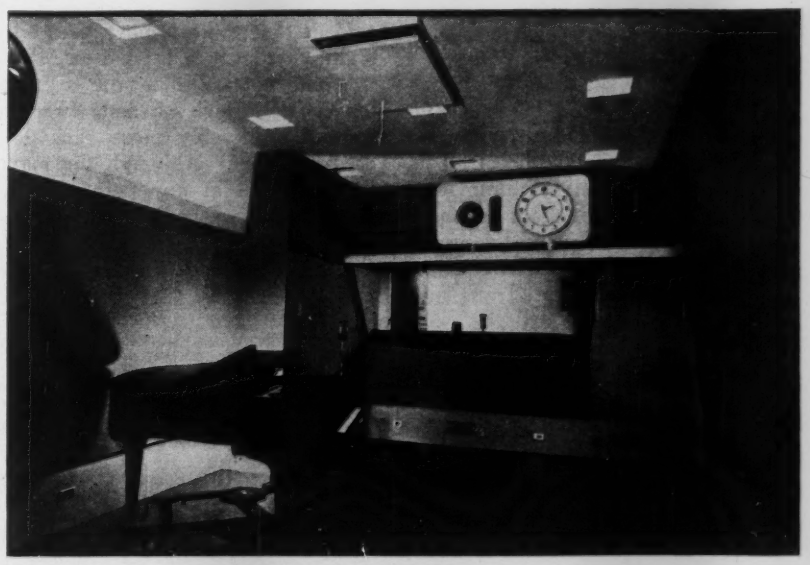


Fig. 6. Inclined, sound-absorbent walls feature acoustical control in the studios. Sloping glass in control booth eliminates light reflections inside.

Personnel

William Lescaze, New York, architect, planned and designed the buildings of Columbia Square. Assisting him were: Earl Heitschmidt, Los Angeles, as associate architect; Fred N. Severud, New York, as structural engineer, and S. B. Barnes, Los Angeles, as associate structural engineer; Torgesen & Bernstrom, New York, as mechanical engineers with Ralph Philips, Los Angeles as associate; and Prof. Vern O. Knudsen, University of Southern California, as acoustical consultant. The contractor was the Wm. Simpson Construction Co., Los Angeles.

Rates of Debris Collection by Check and Storage Dams

Debris basins prevented disaster to Southern California towns in flood of last March, but water storage reservoirs lost considerable capacity

DATA on the amount of debris carried by mountain streams in flood, the more valuable because of the rarity of information of this sort, has been accumulated as the result of the Southern California storm which peaked on March 2, 1938. Of the 15 flood-control reservoirs in that territory, several were very seriously effected by debris accumulations and the average capacity loss was 12½ per cent. Debris basins more than justified their construction and prevented a repetition of the 1934 disaster in the Montrose-La Crescenta area. In the table below are summarized data from an exhaustive report recently released by the Los Angeles County Flood Control District on precipitation, runoff and other effects of the storm.

Rainfall reached 30 in.

Total rainfall for the storm increased from about 7 in. near the ocean shore to a maximum of 30 in. in the more exposed mountain locations and decreased again to about 4 in. in the desert beyond the mountains. As an average, the maximum rainfall for a 24-hr. period was such that its probable recurrence frequency in this region is 65 years. The runoff peaks for the large catchment areas equalled or exceeded any known peaks during previous floods. Most of the debris accretion, even where previous surveys date back some years, is ascribed to the March 1938 runoff. The quantity of debris lodged in the several storage reservoirs (as distinct from the debris basins not designed for water storage) is recorded in the accompanying table.

Not an abnormal storm

After analyzing meterological conditions which led up to the heavy, continued precipitation of this storm the report concludes, "It is evident that there is no reason why a situation such as existed on March 2 could not continue for a much longer time interval and therefore cause considerably more rain than occurred then." Although the maximum rainfall at any point for the 5-day storm was only slightly more than 30 in., 15.96 in. fell at Opid's Camp (in the mountains) in a 24-hr. period.

The destructive flood on New Year's day in 1934 (*ENR*, Jan. 11, 1934, p. 51) left some 659,000 cu. yd. of debris in streets of the La Crescenta-Montrose residential district. In contrast with this, the flood of Mar. 2, 1938 found that area protected by nine debris basins which caught debris from a major part of the contributing water shed. After the 1938 storm these nine basins contained a total of 541,000 cu. yd. of debris which otherwise would have gone on down into the residential districts, practically duplicating the 1934 flood disaster.

Rate of erosion

In these debris basins for the first 160 ft. back from the spillway lip the surface of the debris was left on a 2 per cent slope. Then there was an abrupt change of gradient to a 7 per cent slope which continued upstream beyond the basin, usually burying the inlet structure under 3 to 12 ft. of debris. Average rates of erosion for the 10.01 sq. mi. of watersheds above these debris basins (exclusive of the Verdugo watershed) amounted to 60,000 cu. yd. per sq. mi. as compared to the 51,000 cu. yd. per sq. mi. estimated as the average above storage reservoirs.

Both of these estimates include debris deposited by the flood in the channels a short distance above debris basins or reservoirs. Assuming that all debris moved by the storm was deposited during the 24-hr. period of maximum flood, debris content ranged up to 30 per cent of the total volume of flow. Many of the drainage basins include recently burned-over areas and in some cases erosion was further increased by recent road-grading operations.

SILTATION OF LOS ANGELES COUNTY RESERVOIRS AFTER FLOODS OF MARCH 2, 1938

Reservoir	Spillway elevation	Date of previous survey	Capacity at spillway elevation previous survey (acre-ft.)	Capacity at spillway elevation April 1938 (acre-ft.)	Loss in capacity since previous survey (acre-ft.)	Per cent of capacity lost since previous survey
Pacoima	1,950.0	Jan. 1936	5,592	5,092	500	8.9
Big Tujunga	2,290.0	1928	6,240	4,720	1,520	24.4
Devil's Gate	1,054.1	Nov. 1934	3,996	3,012	984	24.6
Eaton Wash	887.4	Nov. 1937	940	695	245	26.1
Sierra Madre	1,172.5	1932	47	8	39	83.0
Big Santa Anita	1,316.0	Feb. 1936	1,014	687	327	32.2
Sawpit	1,360.0	July 1936	389	320	69	17.7
San Gabriel No. 1	1,453.0	Extrapolation of 1937–1938	53,700	48,498	5,202	9.7
San Gabriel No. 2	2,385.0	Jan. 1936	12,298	10,802	1,496	12.2
Big Dalton	1,706.0	Nov. 1934	1,053	964	89	8.4
San Dimas	1,463.4	Nov. 1935	1,426	1,166	260	18.2
Puddingstone Div	1,152.5	June 1936	121	43	78	64.5
Live Oak	1,497.0	Mar. 1936	243	226	17	7.0
Thompson Creek	1,640.0	1932	812	786	26	3.2
Sunset Canyon	1,603.7	1929*	5	2	3	60.0
Totals and Average			87,876	77,021	10,855	12.4

* Corrected to 1938, before the storm.

FIG. 1. GREEN MOUNTAIN DAM ON THE BLUE RIVER WILL BE THE FIRST UNIT OF THE COLORADO-BIG THOMPSON PROJECT

Colorado River Goes East

***Contents in Brief**—Diversion of part of the headwaters of the Colorado River eastward under the Continental Divide to meet irrigation requirements on the east slope has been begun by the Bureau of Reclamation. The project includes several dams, canals, a 13-mile tunnel and power plants. The initial work will be power supply lines, the trans-mountain tunnel and Green Mountain Dam, contract for which has been let.*

WHEN the Colorado River seven-state compact was signed, allocating to the upper basin states 7,500,000 acre-ft. annually, it was assumed that plenty of irrigable land existed west of the mountains to utilize this quantity of water. Subsequent surveys disclosed a disappointingly small acreage requiring not to exceed 4,000,000 acre-ft. of water. A possible outlet for the surplus was diversion to the more accessible and populous plains areas east of the mountains, and investigation of these irrigated areas that needed supplemental water for fall irrigation and that could pay for high-priced water disclosed that a shortage existed on 615,000 acres.

Thus came about the Colorado-Big Thompson project, to cost $44,000,000, on which the U. S. Bureau of Reclamation has started construction by awarding the contract for the Green Mountain Dam on Nov. 16, 1938 (*ENR* Nov. 24, 1938). Primarily an irrigation development, the project as planned includes power development accounting for half the cost of the work. A fairly good idea of the combined engineering works can be had from the schematic profile shown by Fig. 2; they make an impressive showing.

The structures planned

Working backward to the deficit or required water figure for which to design the diversion tunnel and storage facilities, it was concluded that ½ ft. depth per acre over the 615,000 acres or 310,000 acre-ft. should be diverted from the Colorado River headwaters to the eastern slope. In the actual plan an extra 10,000 acre-ft. is provided for transmission losses, bringing the capacity to 320,000 acre-ft.

Storage needed

Since for fall irrigation the water must be delivered in 75 days following July the problem was to find as much storage as possible on the eastern slope for water brought over prior to July and to provide a tunnel of sufficient capacity to carry the remainder in 75 days. Storage possibilities back of hogbacks in three reservoirs aggregating 237,500 acre-ft. were located, and a tunnel section and grade were designed to carry 1,100-acre-ft. per day or 550 sec.-ft. for 75 days to deliver the balance of 82,500 acre-ft.

In somewhat more detail the general plans for the project provide for: (1) The storage of 482,000 acre-ft. in Granby Reservoir, to be formed by

construction of a dam 223 ft. high across the Colorado River, 6 miles northeast of Granby; (2) Pumping the water an average height of 130 ft. into Shadow Mountain Lake, a small lake formed by the North Fork diversion dam, and connecting with Grand Lake at the same water surface elevation; (3) The diversion of 550 sec.-ft. of water through a tunnel 13.1 miles long extending from the east end of Grand Lake through the Continental Divide to a point in the watershed of the Big Thompson River near Estes Park; (4) Carriage of the water in the Big Thompson to various points where it will be utilized for power development, stored in the Carter Lake, Arkins and Horsetooth reservoirs, and finally distributed through existing irrigation systems to the lands in the Northern Colorado Conservancy District; (5) the construction of power plants and transmission lines; and (6) The construction of a replacement reservoir on the Blue River at Green Mountain.

Construction timetable

Early need for power for construction purposes, especially in driving the long tunnel, and assurance to the west slope water users of continuity of service dictated early construction of the transmission lines, and they are now under construction. For similar assurance, and also because construction is a matter of considerable time, construction has been started on the Green Mountain Dam. As the 13.1-mi. tunnel represents the bottleneck in the construction schedule, requiring some six years to complete, an immediate start on it is also planned.

Power and pumping plants

Other works in the initial development, but not to be started for two or three years, include Power Plant 1, at the entrance to Estes Park, which will use the water from the long tunnel via conduits, siphons, tunnels and canals to a 704-ft. drop to the Big Thompson River; Granby Dam; Shadow Mountain dam and pumping plant; and the three east side storage reservoirs, Carter Lake, Horsetooth and Arkins, with feeders and outlet canals.

Available funds

An appropriation of $2,150,000 is available for the fiscal year of 1939, some $900,000 being carried over from 1938. Preconstruction surveys with borings and test pits for close location of damsites are under way. A $350,000 administration headquarters at Estes Park will be constructed as well as camps at Green Mountain and at the west portal near the east end of Grand Lake. It is planned to set up two main construction offices on the west slope now and move the personnel to the east slope some two or three years hence. The structures on which work has been or will presently be undertaken are the transmission lines, the Green Mountain Dam and the transmountain tunnel.

The power lines consist of a 69,000-volt line from the hydro-electric plant of the power company at Dillon to the Green Mountain Dam and thence to the Granby pumping plant and the Grand Lake west portal. On the east side, for construction use, a permanent 115,000-volt circuit will be built from the Valmont steam plant near Boulder to the hydro plant at Estes Park and to the east portal. Originally it was planned to carry a line over the divide; probably this will not be built, but to connect east and west sides a submarine cable will be placed in the completed tunnel.

Green Mountain Dam

The award of the contract for the Green Mountain Dam permits general structural features to be given in some detail and this is done in the accompanying page of drawings. The reservoir formed by the dam will flood 2,100 acres of land and will have a capacity of 152,000 acre-ft. The irrigation outlet capacity will be 1,000 sec.-ft. and the power outlet capacity 1,500 sec.-ft. The spillway capacity will be 25,000 sec.-ft. The excavation and fill will involve 3,500,000 cu.yd. including a 2,000-ft. diversion tunnel of 18x18-ft. horshoe section capable of discharging 6,000 sec.-ft.

Tunnel under the Divide

The largest unit of the project is the Continental Divide tunnel: this has a horseshoe section 9.5 ft. in diameter inside the lining, is 62,023 ft. long and is lined throughout with 9 in. of concrete. The tunnel will extend from the east end of Grand Lake to Wind River, southwest of Estes Park. The principal items of work are the excavation of 257,000 cu.yd. of rock and the placing of 64,000 cu.yd. of concrete.

The Colorado-Big Thompson proj-

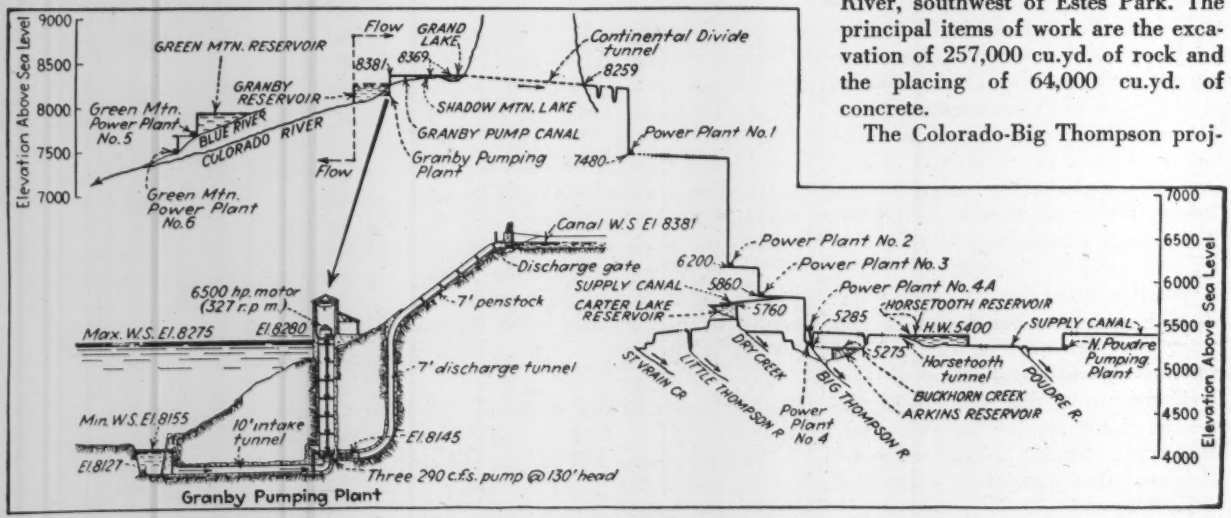
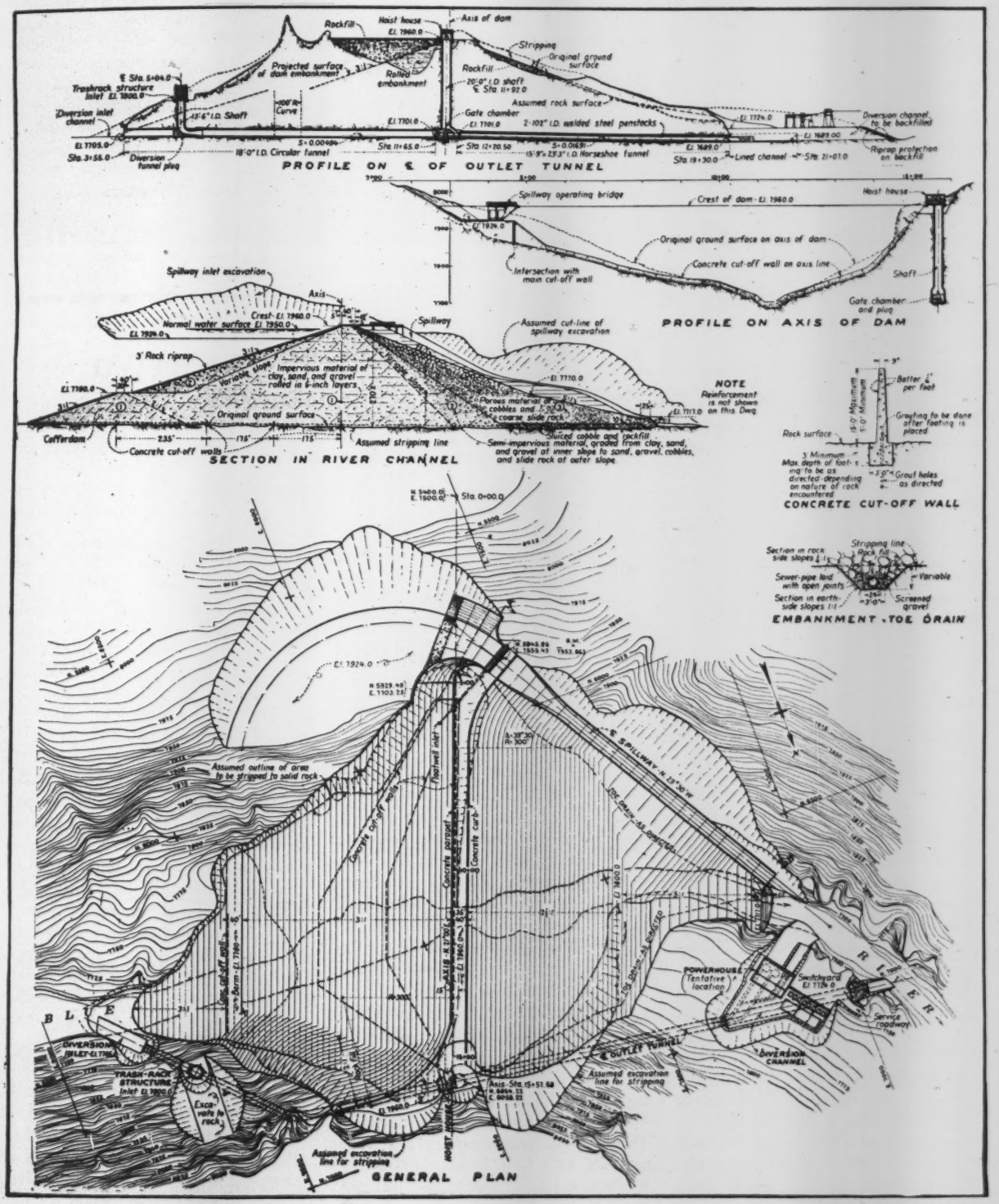


Fig. 2. Schematic profile of the structures of the Colorado-Big Thompson development of irrigation and power, with enlarged profile of the Granby pumping plant.

ect is being built by the U. S. Bureau of Reclamation for which John C. Page is commissioner, Washington, D.C., R. F. Walter is chief engineer and J. L. Savage is chief designing engineer, located in the Denver office. Porter J. Preston, senior engineer, is directly in charge of the project. A contract for the construction of Green Mountain Dam was let on Nov. 16, going to the Warner Construction Co., Chicago on a bid of $4,226,000, which includes the power plant at the dam. Its location is shown on the drawing below.



U. S. Bureau of Reclamation Drawing

Fig. 3. Green Mountain dam, now under contract, is to be a rolled-earth and rockfill structure 270 ft. high.

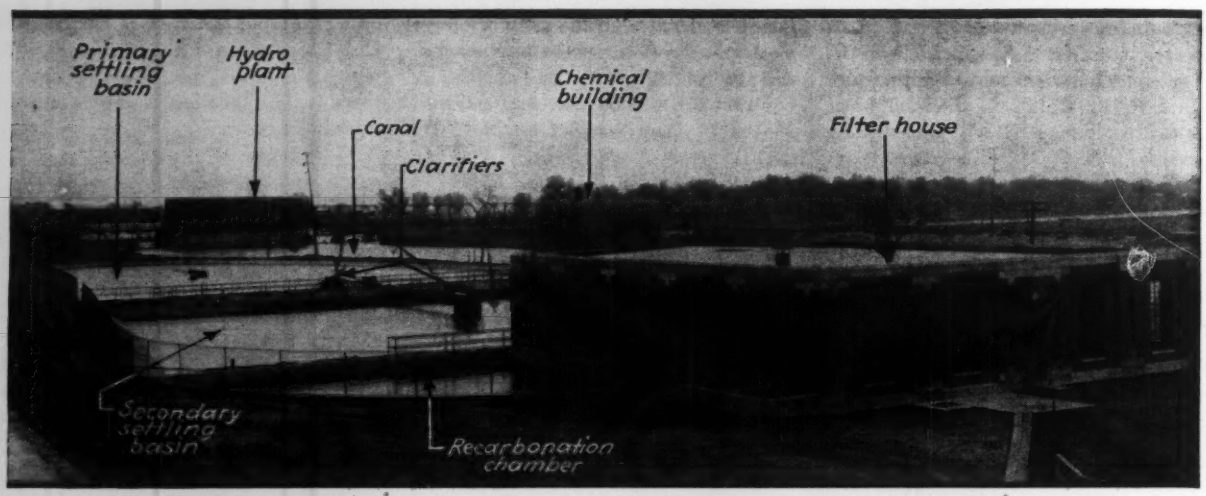


FIG. I. OTTUMWA WATER SOFTENING PLANT WITH THE HYDRO-ELECTRIC POWER PLANT IN THE BACKGROUND

Waterworks Efficiency at Ottumwa

W. W. DeBerard

Associate Editor, Engineering News-Record, Chicago

Contents in Brief.—The municipal water system at Ottumwa, Iowa, has been under the skillful management of one superintendent, Horace A. Brown for 27 years. Since 1910 the system has been considerably expanded and its operation improved, the accounting and billing systems have been modernized, the funded debt has been nearly all wiped out, and the public has been made conscious of the asset value of its water supply properties. Novel devices have been installed in the purification plant to keep the treated water in the best possible condition.

UNUSUALLY good public relations, a sound financial plan, efficient management and progressive application of new developments in water purification give to the water supply system of Ottumwa, Iowa, a character which sets it apart from the many systems of somewhat similar size scattered over the country.

Twenty-seven years ago *Engineering Record* (May 12, 1912, p. 494) carried an article describing a new filter plant just completed by the city of Ottumwa, Ia. (See May 12, 1912, p. 494). In 1910 the city had purchased the plant, built in 1880, from a company which had been in receivership four times in the 30 years of private ownership. Six years ago the city built another purification plant including elaborate provisions for softening. Municipal management has been a success. The superintendent, Horace A. Brown, came to the water department as a young engineer from Maine about the time the old company sold out and has continued in charge for the city from that day to this. To his New England ideas of thrift, high grade service and initiative, and to proper public relations largely is due the present enviable position of the waterworks.

The answer to the excellent financial and physical condition lies in a number of items, foremost of which is a water power plant adjunct which netted $103,535 this year. The total operating profit for the department (water and hydro plant) for 1938 exceeds $135,000. Other factors are the non-political continuing management (three 6-yr. trustees, one appointed every two years by the mayor), the public relations policy of treating all alike (people pay their bills, annual delinquencies being but $200 to $300), and a staff which keeps abreast of scientific water purification and mechanical developments. (Since the Des Moines River is heavily polluted by the capital city of the state, 90 miles upstream, and runs from 20 to 25 gr. per gal. hardness, the water must be watched with a hawk's eye to maintain a bacterially safe water but particularly to keep the softened product on the razor edge between corrosive action and carbonate deposition).

An inspection of the plant in November disclosed many large and small arrangements, clever and ingenious gadgets, time and money-saving methods, and a general feeling of inside interest and knowledge that could hardly result in any but highly efficient operation and maintenance. Of special pride to the officials is the fact that the department will be free of debt in two years.

Little debt

The sale price of this plant to the city in 1910 was $280,000; subsequent extensions and improvements,

including an addition of 52 miles of mains, have amounted to $1,700,000. Present bonds outstanding amount to only $108,000. They will be liquidated as they come due in 1939 and 1940. Aside from $385,000 in taxes (none levied since 1926) the remaining capital has come almost entirely from earnings. With such a financial record one might expect a high water rate. It is low; a step-rate schedule starting at 25c. per 1,000 gal. up to 30,000 gal. per month with a 10 per cent discount for prompt (10 day) payment. At the bottom of the schedule one notes that for 6 m.g. or over per month the rate is 6½c. Ottumwa, a city of 35,000, has a fair quota of industries, including the fifth largest packing house in the country, yet per capita consumption is low, being only 85 gal.

Water power pays

The original waterworks property included a water power development one mile upstream from the filter plant, which is near the center of the city. Brown saw the possibility of increasing the head and quantity of water by a 200-ft. canal extending to a point just below the filters, where three 1,250-kva. turbines could be installed to utilize practically the whole average flow of the river at a maximum head of 14 ft. This change was made, and later a favorable contract executed with the local power company by which all surplus current is sold at the bus bars. During extreme low water and during floods, power is purchased from the company.

Purification plant kinks

In the purification plant, as in every other layout of similar intricate nature, a live superintendent is continually taking advantage of newly developed equipment and new ideas.

In most softening plants the causticity of the effluent is regulated by CO_2 recarbonation to attain a pH that experience indicates will not corrode or permit deposition of carbonate. Zero in the effluent of this plant is at a pH of 7.7 to 7.8, but it is felt that it is best to maintain causticity at a point where the water has a tendency to deposit a slight carbonate film. In consequence the pH is maintained at 8.2 to 8.3. A regulator is employed to maintain a constant pH. Electrodes are immersed in water pumped to a tank from the recarbonation chamber. The resistance varies with pH, and the resulting variance in current passed at 1-min. intervals reacts to actuate a motor opening and closing a 6-in. valve feeding CO_2 to the recarbonation chamber. A chart shows regulation of the pH content between 7.2 and 8.4 after the first few minutes of "fishing" after starting operation.

Supply from the recarbonation chamber to the Micromax, as the regulator is called, is pumped by a small centrifugal unit, and some difficulty was encountered originally from losing suction due to CO_2 gas accumulating in the scroll of the pump. This trouble was eliminated by inserting in the 2-in. suction line a 12-in. flanged tee picked up in the pipe yards. The side outlet of the tee was placed on top and the accumulated gas drawn off by a rubber hose led upward to the atmosphere.

Originally the CO_2 was made in a boiler by burning anthracite rice coal fed by a stoker. An oil burner is now used, the stoker having burned out. It requires 0.02 gal. of oil per 1,000 gal. of water. A condenser absorbs the heat in summer, while in winter the buildings are heated with the steam. A gas scrubber for the flue gases consists of a rectangular con-

Fig. 2. Horace A. Brown, superintendent, left, tells Editor DeBerard how his plant has been developed into a successful property.

OTTUMWA WATER WORKS

BRING THIS CARD WITH YOU — OFFICE HOURS—8 A. M. to 5 P. M.

Water Bill from 9/7/38 to 10/31/38

May be paid at UNION BANK & TRUST CO. first to tenth

BILL RENDERED OCT. 31 1938

T. HENRY FOSTER.
423 N. MARKET ST.,
OTTUMWA, IOWA.

	READING Cubic Feet	GALLONS 7½ per Cu. Ft.		
Present Reading	835.00	14250		
Previous Reading	816.00			
Amount Used	19.00			
Rate per M. Gal. 25¢		Gross Bill	3.56	3.56
		2% State Tax	.07	.07
		Meter Rental		
		Delinquent		
		Amount Due	3.63	3.63
IF PAID BY NOV. 10 - DEDUCT			.37	.37

Checks mailed in payment of this bill must bear POST MARK not later than the 10th of the month following that in which water is used, to entitle consumer to discount. See other side for rates.

Fig. 3. Meters are read fast and clerical work is minimized by meter readers who record the reading directly on this postcard bill on which a clerk in the office adds the previous reading and calculates the amount due.

crete tank containing 4 ft. of gravel in the bottom over a supporting underdrain system of novel concrete ridge-and-furrow type similar to that used in the filter bottoms. Above the gravel is a space 2 ft. high containing the spray grid, and above the latter is a 12-in. mat of excelsior replaced twice a year. The concrete has shown no deterioration.

Hand setting eliminated

Leaving the top of the scrubber the gas is sucked through a 6-in. motor-operated double-leaf valve in which one of the seat rings has been replaced by a Cippoletti weir-shaped orifice. It is this valve which responds to the pH regulator. The automatic control has eliminated all hand setting, and the results are no red water and no deposits. The 200 to 300 nozzles in the aspirator mixer are of special bronze painted with bakelite varnish and show no deterioration after 6 years of use.

As a last health precaution chlorine and anhydrous ammonia are fed into the high-duty pump suctions. Average chemicals used are 2 to 3 gr. per gal. of iron sulphate, 9 to 10 gr. per gal. of lime, 6 gr. per gal. of soda ash, 6.1 lb. per m.g. of chlorine, 3.4 lb. per m.g. of ammonia, 0.16 gr. per gal. of activated carbon. The total chemical bill in 1937 was $25,000, about $25 per m.g., for which the city gets a slightly caustic water and a reduction in total hardness from 20 to 25 gr. per gal. to 5 gr.

Distribution system

The original Ottumwa distribution system had good materials and equipment. Only a few valves and hydrants are replaced each year. Most of the pipes are cast iron, none being less than 4-in. diam. The 5,500 meters are set just inside basement walls, 2 ft. above the floors. They are considered sufficiently accurate for such long periods as to require no regular schedule of removal. Most removals are for freezing or hot water damage to disks. When work is slack leaks are sought by use of a microphone and an electric detector.

Meters read fast

Brown claims for his system that it results in unusual speed in reading. Some 300 readings per day is the average, with tops at 330. Meters are read quarterly, one quarter of the residential area being covered in rotation each month. Packs of 60 or so "not at home" cards are rounded up the last day, the reader using a light truck. Large commercial and industrial meters are read every month. the largest every week for check only. Readings are set down with indelible pencil on a postcard bill which does not have on it the previous reading. The latter is entered on the card in the office at the same time that the new reading is posted in the office ledger. Calculations are made in the office (not by the reader) on the postcard bill and in the ledger. The card is mailed to the customer and on payment a stub at the end of the postcard is cut off for checking and file, while the remainder of the card is the customer's receipt.

Delinquencies are a minimum, only $200 to $300 per year being finally uncollectable. In case of disputes over high bills from leaks the customer is asked to read his own meter night and morning. Straight reading dials facilitate this procedure. In this connection it is a good place to record that the superintendent is the last resort of a customer with a complaint and "equal treatment to all" is his standard basis for good public relations. The three trustees never interfere with the superintendent's decisions in matters of this kind.

Public relations

Brown is part and parcel of the town's boosters, head of the Chamber of Commerce and active in promoting the city's important public improvements other than strictly waterworks. Close contact is maintained with the local newspaper, the *Courier*. A reporter-photographer was on my trail soon after I called and most of the pictures illustrating this article are his offering. It is believed that the engineer in public service can best maintain good public relations by active interest in projects of which he has special knowledge. At the time of my visit the department was sponsor for a WPA project filling in a parking area below the purification plant opposite and a single block away from the main business street. About 1,000 cars can be accommodated.

Long time tenure of employment in the Ottumwa waterworks is the rule and contributes to efficiency and responsible character of the work done. The foreman of the distribution system has been 21 years on the job, and four men under him 20 years each, the two meter readers 16 and 18 years respectively and one filter operator 40 years. The chemist is a newcomer; he has been employed only since 1929!

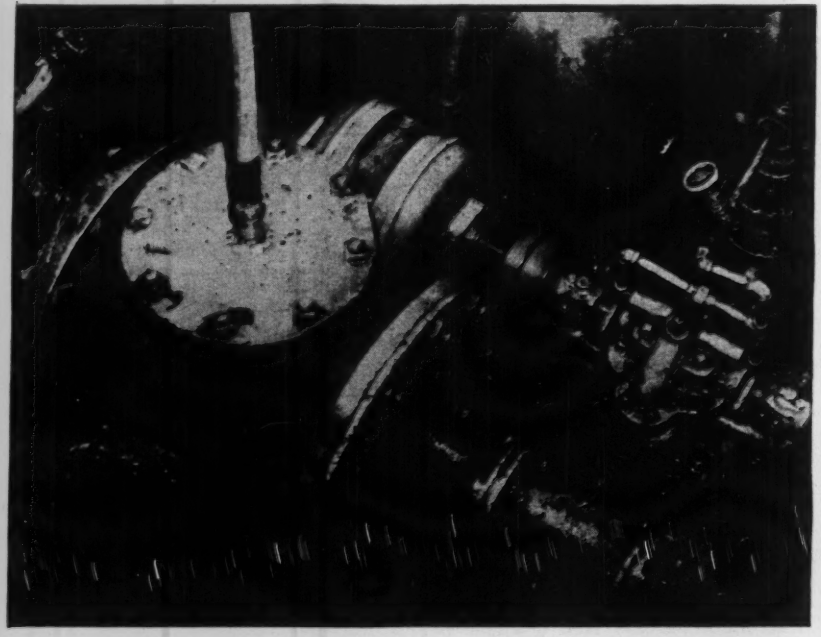


Fig. 4. Gas separator made out of 12-in. flanged tee inserted in the suction line of the pump which sends a sample of recarbonated water to the pH machine.

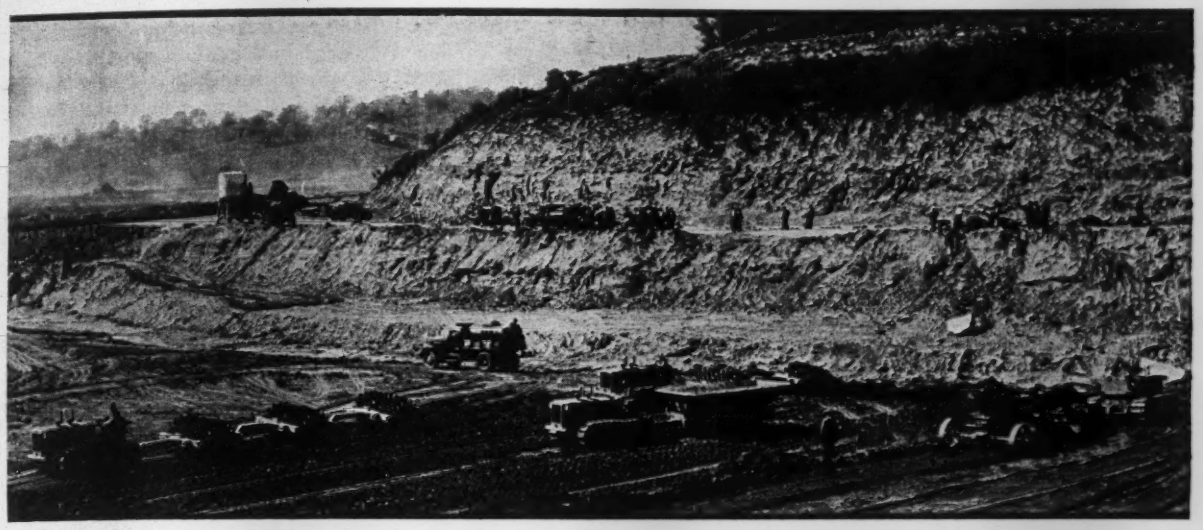


FIG. 1. RECONSTRUCTION OF REDESIGNED MARSHALL CREEK DAM REQUIRES PLENTY OF EARTH-MOVING EQUIPMENT.

Rebuilding Marshall Creek Dam

***Contents in Brief**—Marshall Creek Dam near Kansas City failed last year as the result of a foundation slip. It is now being rebuilt by the WPA under supervision of the army engineers.*

The axis of the dam has been moved back somewhat from the river, the clay soil which was responsible for the slide is being stripped off to the underlying rock and the new structure is being built as a combined rolled fill and hydraulic fill with flatter slopes than in the original structure. More spillway capacity is to be provided.

Construction equipment was bought by the government direct from manufacturers at 40 per cent less than the cost to private contractors.

Out of the wreckage of the Marshall Creek Dam in Wyandotte County, Kansas, which failed by slumping during construction last year, there is being built a new, substantial combination rolled earth and hydraulic fill dam.

Original construction

The downstream portion of the original dam, while being built by WPA, suddenly slumped on Sept. 20, 1937, when the embankment was within 10 ft. of its intended height of 90 ft. (*ENR* Sept. 23 and 30, 1937, p. 495 and 532). An engineering board of investigation reported on Feb. 11, 1938, "The failure of the dam resulted from a plastic movement of those foundation soils deficient in shearing strength in the region about 100 ft. downstream from the centerline. The plastic movement was caused by overloading the foundation by a combination of height of dam and steepness of slopes."

WPA is doing the reconstruction, but this time the work is under the engineering direction of the U. S. Engineer Department, Missouri River Division, which was employed by WPA after the original dam failed to furnish all plans and specifications for the completion and technical supervision of the work. The specifications describe WPA as contractor.

The original dam, containing about 1,000,000 cu.yd. of fill, was built with steep slopes: 1 on 2 and 1 on 3 upstream; 1 on 2, 1 on 2½ and 1 on 3 downstream. The center and upstream parts of the embankment were of rolled earth fill, the downstream part was loose rock and earth, rolled in 18-in. layers. A sheetpile cutoff wall on the dam axis was driven 25 to 50 ft. to shale from the bottom of a trench that was later backfilled with puddled clay. Overlying the shale and limestone foundation of the dam were layers of blue clay, 10 to 20 ft. in thickness, interspersed with lenses of clay-loam and loam. Downstream from the axis, blue clay predominated, the extent and thickness of which was not fully determined until after the failure. None of this overlying material was removed prior to start of fill placement, and the subsequent squeezing out of the clay under the load of the rock and earth fill of the downstream shell resulted in failure of the dam. A small diversion conduit had been built through the embankment, and the only provision for lowering the reservoir was an 18-in. bypass line cut into the conduit.

Dam redesigned and moved

Reconstruction involves moving the axis of the dam 160 ft. upstream, flattening the slopes, excavating all of the slumped area to rock—in which

process all suitable materials are recovered for the upstream embankment and the rest wasted—and building the downstream embankment with hydraulic fill of sand pumped from the Missouri River 2,700 ft. away. Reconstruction plans also call for stripping of the loess abutments to rock, installing new and enlarged diversion and control works, and building a saddle spillway to replace a morning glory structure now regarded as inadequate.

Fig. 2. All suitable material in the slumped portion is being recovered for use in the rolled-fill upstream section. Tractor-hauled crawler wagons are used for over-the-hump haul from one side of the dam to the other.

Allis-Chalmers Co. Photo

Fig. 3. Trucks and scrapers handle the long and short haul material, respectively. This is a view of fill and excavation operations at the west abutment. On the bench above the fill excavation for the new outlet conduit is under way.

The slopes will be flattened to 1 on 4 and 1 on 6 upstream; 1 on 4, 1 on 6 and 1 on 10 downstream. The sheet-pile cutoff wall is being removed to permit natural seepage through the dam. Stability will be provided by the downstream embankment of dredged sand. This sand will fill the hole excavated in removing the disturbed foundation materials, will abut against the excavated slopes of the original fill and will extend downstream from the original toe. Fig. 4 shows a typical combined cross-section of the old and new embankments and the disposition of the slumped materials.

The new dam will require some 2,000,000 cu.yd. of fill. About 310,000 cu.yd. of rolled fill is being salvaged from the slump area; 160,000 cu.yd. of earth and rock fill is being moved to the upstream toe; 420,000 cu.yd. of unsuitable material is being wasted; and about 1,000,000 cu.yd. of dredged sand will be required for the downstream shell. The upstream abutments are being stripped of their loess covering to rock, and this material is included in 550,000 cu.yd. of additional rolled fill required for the central and upstream embankments.

WPA buys new equipment

On the original dam WPA used equipment rented from a local contractor. At the start of reconstruction this agreement was terminated, and the WPA organization in Washington bought a trainload of equipment directly from the manufacturer, at

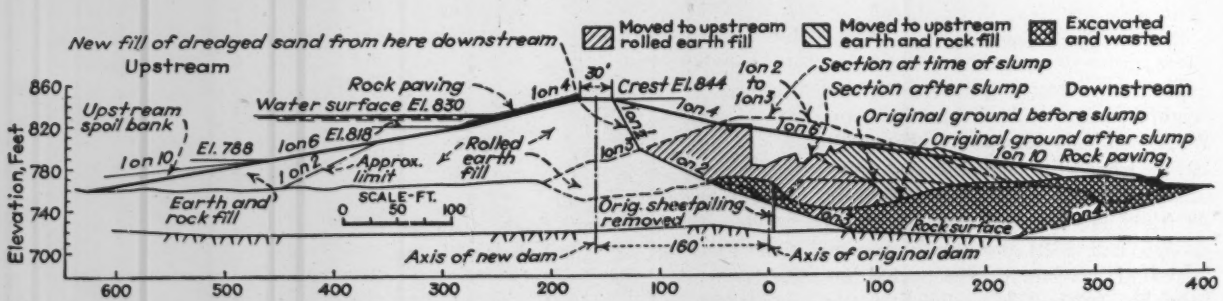


Fig. 4. Because of flatter slopes, the redesigned dam dwarfs the original structure. This cross-section shows the distribution of materials removed from the damaged downstream section. A new downstream embankment will be built of dredged sand.

reported prices some 40 per cent lower than contractors are paying for the same units. A list of the equipment purchased is given in the accompanying table.

EQUIPMENT BOUGHT BY WPA FOR MARSHALL CREEK DAM

1	2½-yd. diesel shovel-dragline
2	1½-yd. diesel shovel-draglines
24	2½-ton dump trucks
6	light trucks
18	60-h.p. diesel tractors
1	50-h.p. gas tractor
1	22-h.p. gas tractor
2	diesel tractors with bulldozers
2	12-ft. drawn blade graders
3	8-yd. carrying scrapers
8	7-yd. crawler wagons
8	8-ft. sheepsfoot rollers
1	heavy ripper
1	26-in. road disk harrow
1	2-yd. rotary scraper
1	315-ft. portable compressor
1	105-ft. portable compressor
1	universal rock drill carriage
1	10S concrete mixer
Misc.	rock drills, pumps, etc.

A smooth-working earth-handling schedule has been worked out that utilizes the different types of equipment to best advantage. In general, abutments are stripped by shovel, dragline and trucks; usable rolled fill material is reclaimed by carrying scrapers; and earth and rock fill is recovered by shovel with crawler wagon haul. Because of the coming deep excavation of the downstream section, the present elevation of the rolled-earth upstream section is limited. Consequently, present excavation operations are producing more material than can be placed in the fill at this time, so considerable material is being stockpiled for future use. Incidentally, undercutting the loess in the east abutment stripping recently caused a small slide, which gave rise to false rumors of a second failure of the dam.

Extreme care is being taken in placing the rolled fill. The trucks and scrapers deposit the material in windrows, after which it is spread by a blade grader. Then the surface is sprinkled by a tank truck to add the required moisture for desired compaction, which is specified as "satisfactory to the engineer." The moistened material is mixed by disk and harrow prior to rolling into 6-in. layers with sheepsfoot rollers. A moisture content of 17 to 20 per cent of the dry weight of material produces the consistency for required compaction. Samples of this fill are taken frequently to check the density of the material.

Plans are now being made for dredging and placing the sand fill. Probably a contract will be let for delivery of dredged material to the dam, the WPA placing the material.

Work is progressing under two shifts daily, 4 a.m. to noon, and 1 p.m. to 9 p.m. A floodlighting system has been installed for proper illumination of the various operations.

Design, engineering and inspection are under the direction of the Missouri River Division, U. S. Engineer Department, Kansas City, Mo. Col. C. L. Sturdevant is division engineer; R. U. Johnson is resident engineer at the job. B. R. Huetter is general superintendent and W. W. Johnson is assistant superintendent for WPA. The commissioners of Wyandotte County, Kansas, are sponsors of the recreational lake development.

Chicago Park Passerelle

L. T. Smith

Structural Designer, Chicago Park District

***Contents in Brief**—A welded steel arch footbridge has recently been erected over Chicago's Outer Drive in record breaking time, closing down traffic but 5 hours. The structure is a 3-hinged built-up steel girder arch, with the two half spans completely shop-welded. The girders were erected by a crawler crane utilizing a temporary center bent set on the pavement.*

The Chicago Park District, which operates many miles of parkways with the heaviest traffic in the United States has found an imperative need for subways or footbridges over the Outer Drive on which there is a minimum of nonstop traffic flow although it runs through a popular lakefront park area traversed by pedestrians seeking the bathing beaches. Traffic flow on the south half of the Outer Drive for 6 miles is not impeded by stoplights and the north half of equal length has few stoplight installations. During the summer months great crowds of bathers and others seeking relief from the heat cross these limited ways with considerable risk and interruption to traffic.

Experience with ramp-approach footbridges which passed unprecedented crowds over the Outer Drive during the Century of Progress Exposition indicated that foot traffic in volume could be handled economically in this way. Since then the engineers of the district have made intensive studies of subway and bridge designs, and a number have been built. Subways, especially at night, are objectionable. On the Lake Front the water table is high and drainage is expensive. On the other hand appearance of the ramp-type footbridge is objected to by property owners.

The first overpass to be built as a result of this study is at 47th St., where low hills adjacent to the roadway lent themselves to the use of an arch with long ramp approaches.

Design conditions called for a minimum clear headroom of 13½ ft., a maximum grade of deck of 10 per cent for pedestrians and a minimum clear width of deck of 6 ft. Use of a hingeless or 2-hinged design would have resulted in a flat span with high temperature thrusts and moments, hence a 3-hinged design was adopted. It proved to be the more practical type, considering its low thrusts, low moments, the fact that it is statically determinate, its ease of erection and its ability to accommodate itself to settlement of abutments with a minimum of stress disturbance. As the site was reclaimed from the lake only nine years ago movements are possible.

The design selected is an all-welded, completely shop-assembled, 3-hinged built-up steel-girder arch, 115 ft. between abutment hinges with a ratio of rise of center hinge to span of 1 to 8.6. To reduce the deck gradient the concrete deck slab occupies a variable position between girders. Use of white cement did not add materially to the cost. Complete shop assembly reduced erection time, disturbed traffic less, gave a better

job of welding, permitted a simpler job organization and reduced the net steel cost.

Abutment thrusts were easily accommodated, soil bearing pressures not exceeding 1,700 lb. being obtained. A live load of 100 lb. per sq.ft. with a 30 per cent impact increment is provided for. The concrete deck was used to secure permanence, freedom from leakage and maintenance troubles. An exceptionally stiff structure was obtained by welding the transverse reinforcing to the girder webs thus getting deep beam action latterly. Most light footbridges are subject to much lateral sway but this span is remarkably stiff. The absence of diagonal wind bracing makes a neater deck underneath.

No attempt was made to adhere to geometrical curves in designing the intrados and extrados of the girders. These lines were determined by the ramp gradient and roadway clearance limits and are merely smooth satisfying curves drawn and faired out to a large scale in the drafting room. Ordinates were scaled off carefully, placed on design drawings and used in the shop in making full size patterns from which to cut the web plates. Plates were cut with an automatic acetylene torch and all welding was electric arc.

Fig. 1. Foot bridge over the Outer Drive, Chicago, built to a new design developed by the Chicago Park District staff.

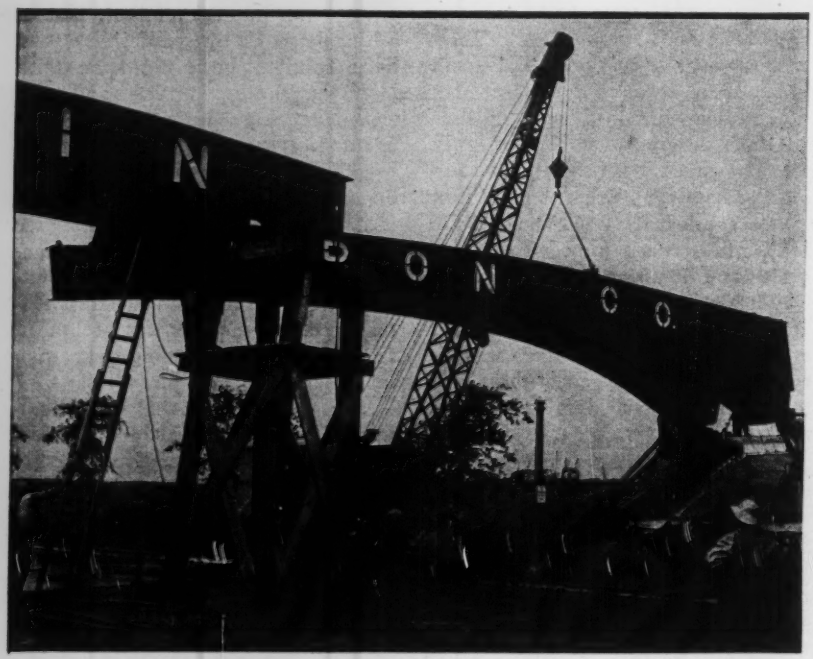


Fig. 2. Crawler crane placing the second half-span unit. A temporary center pier was all the falsework to be erected on the roadway, which was closed only 5 hours.

Each half-span girder with end bearings pinned weighed about 12 tons. Using a crawler crane with 40-ft. latticed boom the two half spans were erected completely in 5 hours during 2 hours of which a rainstorm occurred. After removal of the temporary center bent an additional 2 hours was required to field weld the center hinge assembly but the roadway was blocked only 5 hours as compared with the several days required to erect riveted spans.

No difficulty was experienced in erecting the girders since great care was taken in placing the abutment bearing plates and anchor bolts and in checking shop measurements. To eliminate internal stresses in each bearing unit, the assembly, after complete welding, was given a stress-relief heat to 1,100-deg. Fahr. and slowly cooled to normal.

To save time and to reduce the hazard to cars using the roadway beneath the bridge, flat galvanized steel sheets were used as bottom forms for the concrete deck. The sheets were tack welded to hold them in place, braced with timber crossbeams resting on the bottom flanges and immediately filled with concrete.

The bridge was constructed by the Chicago Park District forces utilizing its own equipment, organization, engineering and supervision. WPA furnished some materials and unskilled labor. The Duffin Iron Co., Chicago fabricated the steel work.

All this work was done under the general direction of Ralph H. Burke and Robert A. Black, chief engineer and assistant chief engineer, respectively, of the Chicago Park District of which George Donoghue is general superintendent and Robert Dunham, president. The writer made the structural design and E. V. Buchsbaum the architectural design under the direction of C. T. Kelly, structural engineer. Nick Murphy was construction superintendent, Ben B. Shapiro, construction engineer and J. P. Gallagher, principal construction engineer.

Work Starts on South Penn Toll Road

Contents in Brief—The Pennsylvania Turnpike Commission has begun work on this country's first major toll road, a 161-mile highway between Harrisburg and Pittsburgh which will use grading and tunnels of an abandoned railroad project started 50 years ago.

The new road is to be the last word in highway construction; four 12-ft. lanes, with opposing lanes separated by a 10-ft. parting strip. Eight tunnels will have 23-ft. roadways paved with brick.

Low grades and easy curves are expected to attract more than enough paying traffic to offset the estimated cost of $60,000,000.

Construction is to be speeded to meet PWA requirements; the whole project is to be completed by June 1940. Included is much heavy grading and seven miles of two-lane tunnels.

THE FIRST grading contracts for Pennsylvania's projected toll road through the mountainous region between Harrisburg and Pittsburgh were let in November and others are expected to follow at short intervals until all the grading work on the 161-mile road is under way. Tunnel contracts will be let early this year and paving will be begun as soon as grading permits. Thus rapidly this $60,000,000 project is being converted from a dream to a reality in order to meet PWA requirements that it must be substantially completed by June, 1940.

The project is of unusual interest because it is the first modern long-distance toll road to be built in this country, and because its antecedents go back a half century to the heyday of railroad building when the Vanderbilts went into the heart of Pennsylvania R.R. territory and spent $5,500,000 in grading for a railroad line along the route which the new road will follow simply to force the Pennsylvania to withdraw its support from the West Shore R.R., which was then making inroads into New York Central territory. Now, after more than 50 years of idleness, the unused fills and tunnels of the abandoned railway line, which was to be the last word in railway construction, are to be put to use to carry what is planned to be the last word in modern highway construction.

The history of the South Penn Highway project was given in *ENR*, July 29, 1937, p. 175. Briefly, just as

Fig. 1. **Fifty years ago the South Penn Railway was setting new standards in railway construction. This picture, taken in 1887, is of a portal of the Rays Hill Tunnel. The man at the left in the foreground is Andrew Carnegie, who is reported to have sunk about $1,000,000 in the project.**

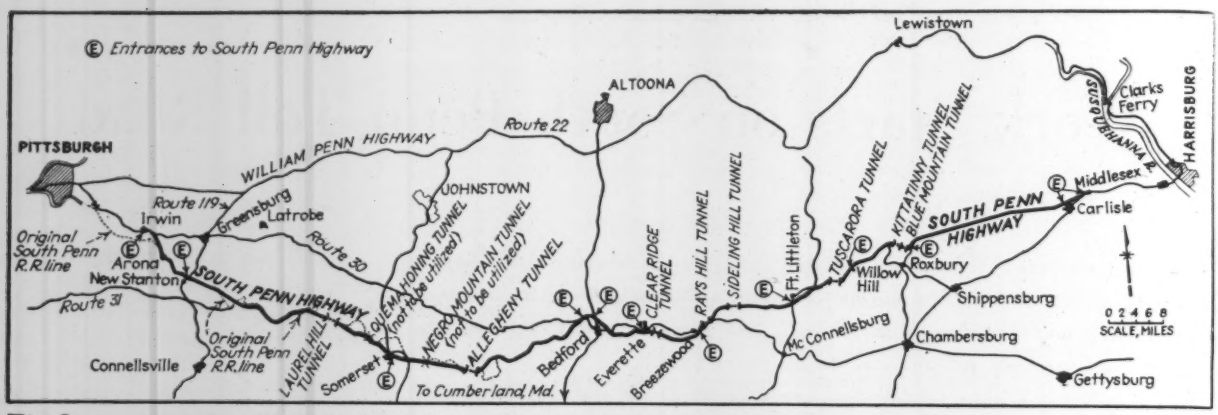


Fig. 2. **The South Penn Highway, following closely the line of the abandoned South Penn Railway, shortens the distance between Harrisburg and Pittsburgh and materially improves grades and alignment.**

the abandoned railway was to be a line with such low grades, easy curves and direct alignment that it could compete successfully with the more circuitous Pennsylvania R.R., so the new toll road with its easy grades and better alignment is expected to give motor vehicles an opportunity to reduce their operating cost far enough below those on existing routes to more than offset the tolls. Added but less tangible benefits are greater safety and reduction in fog and ice troubles through the use of tunnels under the high ridges.

The new highway

The South Penn Highway starts at Irwin, 20 miles east of Pittsburgh on the Lincoln Highway, and runs eastward 160.8 miles to Middlesex, 15 miles west of Harrisburg. It passes through no cities, and all towns along the route are bypassed. Toll stations will be provided at each end and at eleven points along the line, including major highway crossings which will have separated grades and cloverleaf intersections. All railway crossings, of course, will be separated. Minor road crossings with little traffic present a difficult problem for the highway builders. Those which cannot be closed by agreement with local authorities will be carried over or under the new highway. Farm crossings will be underpasses where the cost of acquiring the separated land exceeds the cost of an underpass.

The right-of-way is to be 200 ft. wide, generally, and will be strongly fenced through all settled regions. Much of it was obtained from the railroad company that kept the line's charter alive, but some which had been sold or had reverted to the original owners had to be reacquired.

Grades will be 3 per cent or less as compared with 8 or 9 per cent on the existing highways. These low grades are expected to speed truck movements materially. The vertical rise on the new line in crossing the mountainous plateau region between Pittsburgh and Harrisburg will be 4,000 ft. as compared with 14,000 ft. on the old route. Most curves on the new line will be less than 4 deg. and none will be over 6 deg. The present line has many much sharper curves. All curves are to be spiraled and superelevated for 60 m.p.h., but there will be no speed limit. Superelevation ranges from 1 in. per ft. on curves of 2 deg. 30 min. to 1¼ in. on 4 deg. curves.

The new road is to be a four-lane divided highway except through the tunnels, which will have two-lane roadways initially. Provision is being made for parallel tunnels at some future date if required. A typical cross section of the roadway is given in Fig. 3. Either concrete or a flexible type bituminous pavement will be used depending on local conditions. The bituminous pavement may be used on new fills, at bridge approaches, etc., where settlement may be expected. Either type will be used elsewhere.

There is to be no narrowing of the roadway at the smaller bridges, but on structures of 45 ft. span and over the 10-ft. parting strip is to be reduced to 4 ft., the separation being by a low concrete curb with rounded faces.

There will be six major bridges ranging from 200 to 800 ft. in length and from 40 to 90 ft. high. Minor structures total 65, exclusive of culverts. The original culverts were mostly of stone and many can be extended and used. New culverts are to be of concrete or corrugated iron pipe.

Generally, the railroad location is followed closely, but there have been minor changes, as will be seen by the

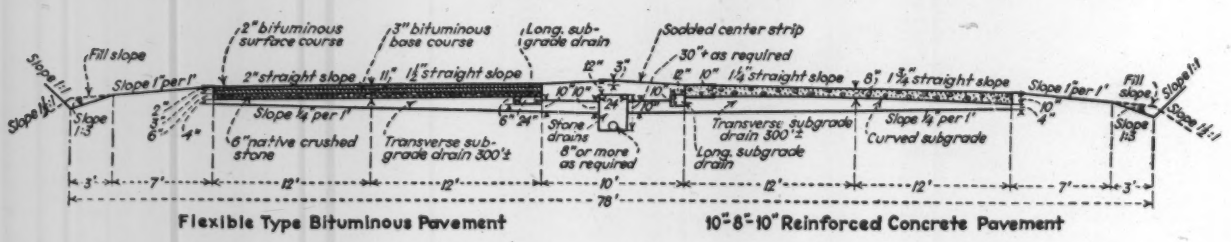


Fig. 3. **The new highway is to have a four-lane divided pavement. Either of the two types here shown is to be used as dictated by local conditions.**

route map, Fig. 2, which have been made possible by the greater flexibility of the highway line. Two major changes involve elimination of Quemahoning and Negro Mountain tunnels, reducing the number of tunnels to eight. A deep cut is to be substituted for Quemahoning tunnel. The remaining tunnels range in length from 1,110 ft. to 6,662 ft., the total length being 6.96 miles. Of this mileage, 4.23 mi. had been excavated by the railroad company, either to single-track or double-track width. To bring these all to two lane width requires 690,000 cu.yd. of excavation.

The tentative tunnel section shown in Fig. 4 is notable. Its total width is 28 ft. 6 in., with two 11 ft. 6 in. roadways and one walkway. The paving is to be brick, as in the Lincoln Tunnel at New York. Ventilation is to be forced, fresh air being pumped into an overhead duct at each portal and fed to the tunnel through ceiling ports. The tunnels are to be lighted but the open road will not be.

Tunnel driving, lining and paving is to be let as one contract as it is believed that overbreak beyond the pay line will be materially reduced thereby. Also, the engineers believe that the work can be better integrated and speeded up by having all work in each tunnel under one contract. Tunnel bids will be called as soon as full information on rock conditions is obtained and specifications prepared, which probably will be by late winter.

Large quantities of grading are involved over much of the line, running as high as 300,000 cu.yd. per mile. For that reason grading contracts will be of limited length to speed completion. The first two contract sections each are ten miles long.

Embankments on the rail line were built for single track, hence much widening of existing banks will be required. To minimize unequal settlement, existing banks are to be scarified, and the slopes notched to give proper bearing for the new fill. New banks are to be of rolled earth or rock, the earth layers to be not over 8 in. thick.

Traffic studies

Extensive studies of potential traffic for the highway were made by Parsons, Klapp, Brinckerhoff & Douglas, New York, and were checked by the J. E. Greiner Co., of Baltimore. Count of existing traffic showed 3,500,000 vehicles on Routes 30, 22, 40, 6 and 20 in 1937; of these, 2,030,000 were rejected as not prospects for the new toll road, leaving 1,470,000. Normal growth estimates brought this to 1,940,400 potential users by 1941. However, as it was recognized that a certain number of the prospects would not pay tolls a reduction of 30 per cent was made bringing the estimate for 1941, the first year of operation, to a net of 1,358,280 vehicles. This number is expected to increase to over 2,000,000 by 1946.

The 1941 figure is broken down as follows:

Pennsylvania passenger cars	580,000
Foreign passenger cars	420,000
Heavy trucks	180,000
Medium trucks	90,000
Light trucks	20,000
Buses	10,000

No tolls have yet been set, but those given in the accompanying table were recommended by the consulting engineers. Using these as a basis, gross earnings of $2,670,000 are estimated for the first year and $4,832,000 for the 10th year, or an average of $4,117,200. After deducting operating costs of $566,000 the net is estimated at $3,551,200, or nearly three times annual interest requirements on $35,000,000 of Pennsylvania Turnpike Commission 3¾ per cent bonds.

RECOMMENDED TOLLS FOR THE SOUTH PENN HIGHWAY

Type of Vehicle	Gross Weight	One-Way Through-Trip
Passenger cars		$1.50 (Round trip $2.00)
Heavy trucks		
Full trailer	Up to 62,000 lb.	$10.00
Semi-trailer	Up to 39,000 lb.	7.50
Semi-trailer	Up to 30,000 lb.	6.00
Truck	Up to 26,000 lb.	5.00
Truck	Up to 22,000 lb.	4.50
Truck	Up to 18,000 lb.	4.00
Medium trucks	Up to 13,000 lb.	3.00
Light trucks	Up to 7,000 lb.	2.00
Light trucks	Up to 5,000 lb.	1.50
Busses		4.00

The average toll rate for trucks and passenger cars will be $4.75 and $1.25 respectively, per through trip. For vehicles traveling less than the full length of the Turnpike the toll charges will vary from one cent per mile for passenger cars to four cents per mile for heavy trucks.

Cost of this project is estimated at $60,000,000. It is to be met by the sale of the commission's bonds to an amount not to exceed $35,000,000 to the R.F.C., and by a grant not to exceed $26,100,000 from the P.W.A. An installment of $10,000,000 of the bonds has already been sold to the public through the R.F.C. and private bankers.

The Pennsylvania Turnpike Commission consists of Walter A. Jones, chairman, E. H. Jones, Charles T. Carpenter, Frank DeBout and Roy E. Brownmiller. Samuel W. Marshall, chief engineer of the Department of Highways is chief engineer of the commission. Other department engineers are assisting the commission.

In addition to the consulting engineers previously noted, Ralph Smillie, engineer of design of the Port of New York Authority, has been retained as consultant on the tunnel work.

The first grading contract went to L. M. Hutchinson of Mount Union, Pa. It was for a 10-mile section in Cumberland County on a bid of $453,000, which is considered a very favorable figure by the engineers, the major item being 831,000 cu.yd. of Class I excavation, which was taken at 26c a yard. The second contract went to the Girard Constr. Co., Philadelphia on a bid of $444,759.

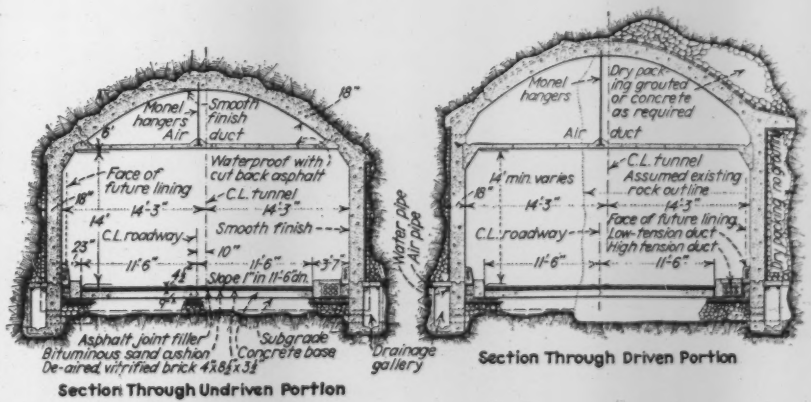


Fig. 4. Tunnel sections vary to meet the special conditions imposed by the driven sections of the old railway tunnel. This section is still tentative.

Improved Field Paint Sprayer

GEORGE D. WHITMORE
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AN important surveying activity in constructing reservoirs by the Tennessee Valley Authority is surveying and marking the reservoir flow lines. In cleared land stakes are set and in woods the contour line is painted on trees (Fig. 2). Search for some device or procedure to speed up the tree painting led to the development, by Paul Morris, chief of a field survey party, of a unique paint spraying device utilizing the evaporation of dry-ice to generate the necessary pressure. This device is now standard equipment for the contour-marking parties.

The spray-gun is a non-bleeder, pressure-feed gun attached to a pint-size paint jar, and is equipped with: (1) an adjustable nozzle for regulating the mixture and width of paint spray; (2) a thumb release for starting and stopping the spray; and (3) a safety pop-off valve at the point where the hose connects with the spray-gun. This is regular commercial equipment and can be purchased at any good equipment store. A 5-ft. length of rubber air-hose connects the spray-gun with the pressure tank.

The pressure tank is an aluminum 8-qt. household pressure cooker, fitted with: (1) a pressure gage recording up to 30 lb.; (2) a safety pop-off valve set to open at 25 lb.; (3) a hose connection, and (4) a handle for carrying. The tank is divided into upper and lower parts by a metal grill supported on legs about 4 in. above the bottom. The tank weighs about 10 lb. empty.

When the upper chamber of the tank is loaded with from 6 to 10 lb. of dry-ice, gas pressure is generated without the use of any accelerating agent. As the ice melts to a smaller size, however, an accelerating agent is necessary. Any liquid of low-freezing point will accelerate the generation of carbon-dioxide gas, water not being satisfactory since it has a tendency to freeze up. Kerosene is used at present, since it will not freeze and is easily obtained. One pint of kerosene is placed in the bottom compartment of the tank. As the dry-ice reduces in size during the day and additional pressure is needed, the tank is tilted over on its side until the kerosene comes into contact with the dry-ice. If too much pressure is built up, the tank is returned to the upright position. With a little practice, it is possible to tilt or right the tank at the proper time, so that just the pressure needed is obtained without any waste. No pressure regulator has been found necessary other than the pop-off safety valves mentioned above. Painting is done best with pressures of from 10 to 25 lb., although it is possible to paint with a pressure of 5 lb.

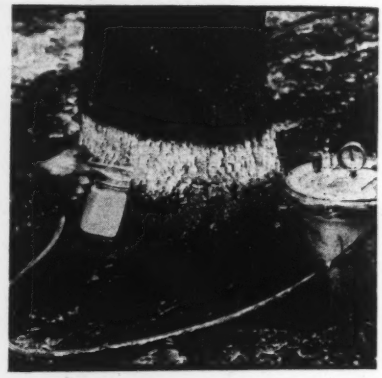


Fig. 2. Painting reservoir margin contour on a tree using dry ice to provide gas pressure for the spray gun.

Aluminum paint, consisting of aluminum powder with special mixing oil, seems to work better in the spray gun than any other yet tried; also it seems to be the most satisfactory for brightness and lasting qualities, and it needs no thinning and seldom clogs the spray-gun. Outside white lead paint also works well when thinned with ½ gal. of linseed oil for each gallon of paint.

At the end of each day's work, the spray gun is placed in a container of turpentine for the night, flushing it well before starting again in the morning. A half pint of turpentine is carried in the field for frequent flushing of the spray gun.

The cost is less than $20 for each outfit. The spray-gun costs about $6, the pressure tank complete with all attachments about $10 and the rubber-air-hose and other incidentals about $2. Spray-painting uses about half as much paint as brush-painting, but this saving is partly offset by the cost of the dry-ice. From 6 to 10 lb. of dry-ice generates all the pressure needed in the average day's work; 1 gal. of aluminum paint and 10 lb. of dry-ice will paint from 150 to 175 trees, each tree having a 4-in. band around the base, with one or two prominent paint-splotches about 5 or 6 ft. high for quick identification.

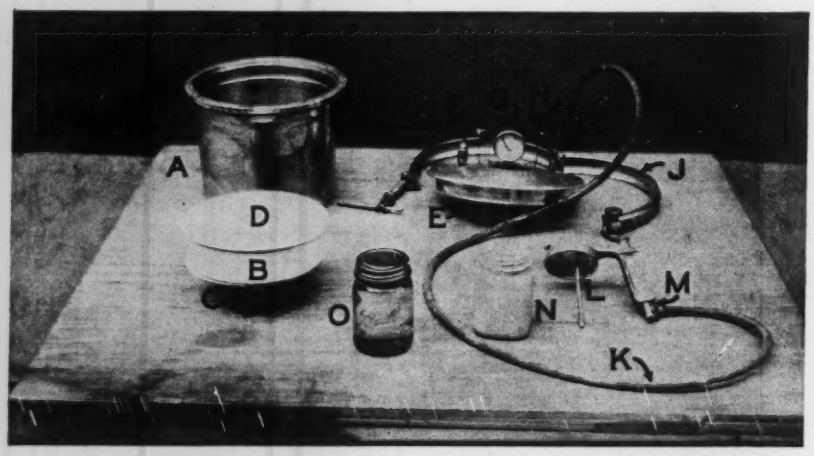


Fig. 1. Dry-ice paint sprayer taken apart for charging.

(A) Base of pressure tank. (B) Pan with holes in bottom, supported on (C) grill with legs to keep pan with ice above liquid in bottom of tank. (D) Dry ice in pan. (E) Top of pressure tank, with pop-on valve, (G) gage to show pressure in tank, (H) handle for carrying tank, and (I) hose connection. (J) metal clamp to hold top and base of tank together. (K) rubber hose between pressure tank and spray gun. (L) Spray gun, with (M) pop-off valve at point where hose connects to gun. (N) Mason jar used as paint container, and (O) Mason jar of turpentine for cleaning and flushing spray gun.

Low-Cost Airport Runway

A. M. MILLER
Assistant Materials Engineer, State Highway Commission, Morgantown, W. Va.

Contents in Brief—By adapting runway design to the local conditions and materials, unusually low costs were obtained in airport construction at Morgantown, West Va. A contractor furnished the mixing and paving plant, the bituminous materials and the skilled labor and supervision; WPA furnished the common labor. Cost figures obtained by this set-up are given.

STUDIED ADAPTATION of local materials to the construction of runways and buildings has enabled the city of Morgantown, W. Va., to get well ahead in constructing a modern airport. Located on a narrow ridge at elevation of 1,250 ft., about 2 mi. from the city and about ¼ mi. from a main highway to the city, the airport site has nearly horizontal sandstone ledge under its soil cover, and the 912,000 cu.yd. of excavation for runways and field included about 500,000 cu.yd. of rock. This excavated rock offered a construction material both in crushed form and as building stone. The other local material was commercially produced crushed limestone in two sizes, ⅜ in. to 200-mesh, and 1 in. to ¼ in.

The sandstone only needed to be crushed to fit it for base construction. Because the airport is a WPA project and had to provide as much employment as possible, the stone was hand broken by knapping. To get the best use of the limestone for surfacing mixes, the department of tests of the West Virginia highway commission advised a two-course premix surface using cutback asphalt. The important objectives required of a runway mixture are high bitumen content (since the surface gets a negligible kneading action by traffic) and stable nonskid surface. Mixtures were set up in the laboratory, using both MC and RC material, and tested with the Hubbard-Field stability machine, the Mimmi wheel apparatus and the stabilometer. The tests indicated two mixtures using RC cut-back as follows: Binder course 0.37 gal. RC-3 per cu.ft. of 85½-lb. loose stone, or 2.9 per cent; surface course, 1.14 gal. RC-2 per cu.ft. of 100-lb. loose stone, or 7½ per cent.

Little that is not familiar to the roadbuilder appears in the runway structure as shown by Fig. 2. One runway (A) was built in 1937. The methods specifically described are those used on runway C, constructed in 1938. In general the methods were the same; the base was built by day labor and the surface by contract.

The base is two courses of knapped stone each compacted to 6 in. by a three-wheel 10-ton roller, with the top course choked with ⅜-in. to dust limestone screenings. On this the surfacing starts with two ¼ gal. per sq. yd. MC-1 prime coats applied three days ahead of the binder course. The 1¼-in. binder and the ¾-in. wearing course are placed separately and the surface is sealed with limestone, 5 lb. per sq.yd. Fig. 3 shows the appearance of the several courses.

Simple plant is adequate

As the work is being successfully carried out, the contractor furnishes the bituminous material, mixing plant, bituminous paver, distributor and skilled labor and the city supplies the necessary trucks, rollers, limestone aggregate and common labor. The contract price is 9c. per gal. MC-1 prime coat applied, 12 c. per gal. for RC-2 and 14c. per gal. for RC-3; the bid prices on the RC-2 and RC-3 included mixing and placing.

A 27-E paver is used for mixing; it is so located that the trucks back up a short ramp and discharge the aggregate into a bin, from which it is fed by gravity into a calibrated hopper and thence directly into the mixer drum.

Surface dried stone is specified for

Fig. 1. Asphalt paver spreads surfacing mix for airport runway.

the mix, and drying is simply accomplished by spreading the damp material over the runway surface and then manipulating it by blade, drag and hand shovels. High moisture content resulted in some balling of the fine stone, but this condition was easily corrected by placing a ½-in. square mesh sieve in the storage bin. About 31 cu.ft. of stone and 11.5 gal. of RC-3 are mixed in each batch of binder course in ½ min., 21½ cu.ft. of stone and 24.5 gal. of RC-2 are mixed in 1½ min. for the wearing course.

A mechanical paver spreads the two courses, 125 lb. per sq.yd. of binder course and 78 lb. per sq.yd. of top course. This results in a compacted thickness of 1⅛ in. binder and ⅝ in. top. A three-wheeled ten-ton roller is used for initial and final compaction; only longitudinal rolling is required. The top dressing of 5 lb. of fine stone is broomed into the surface voids; this acts as a seal.

Common labor, trucks and drivers, supervision, inspection and roller costs are about the same for the construction of both the top and binder courses which is 0.081c. per sq. yd. The itemized costs are as follows:

Top Course:	
Labor, etc.	$0.081
Asphalt—0.813 gal. at 14¢	0.114
Aggregate—(mix and seal)	0.057
Total	$0.252
Binder Course:	
Labor, etc.	$0.081
Asphalt—5.28 gal. at 12¢	0.063
Aggregate	0.122
Total	$0.267
Prime Coat:	
Asphalt—0.5 gal. at 9¢	$0.045
Total cost of bituminous surface	$0.57
Total cost of stone base	$1.53
Total cost of runway, base and surface	$2.10

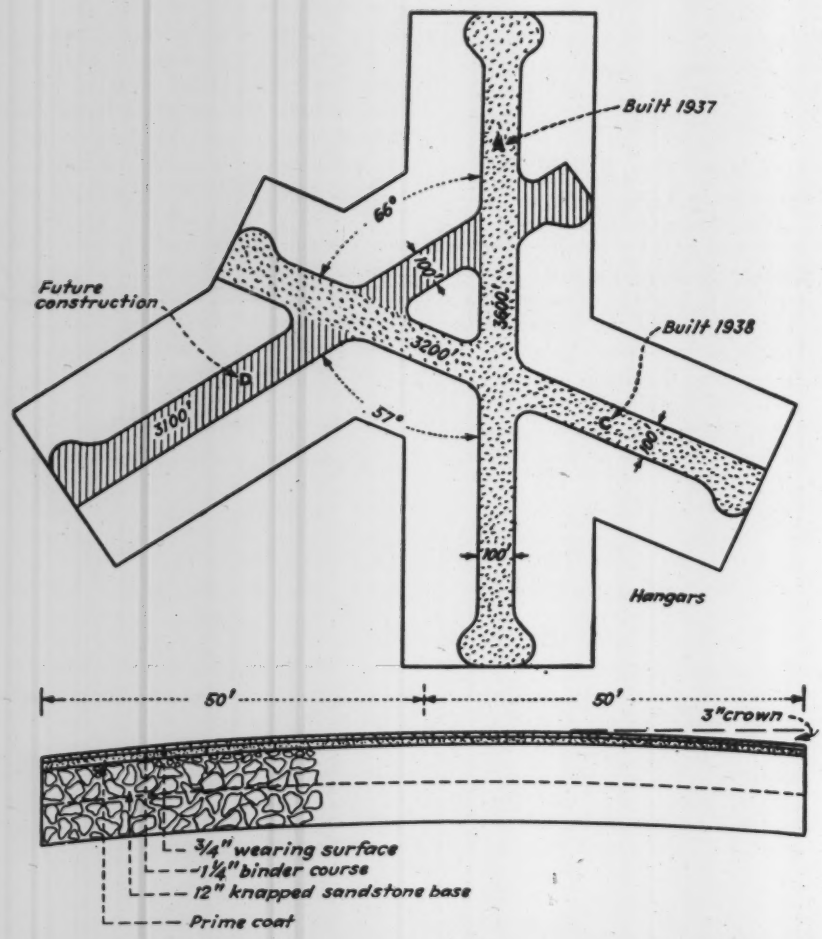


Fig. 2. Plan and section of runways for the new airport at Morgantown, W. Va.

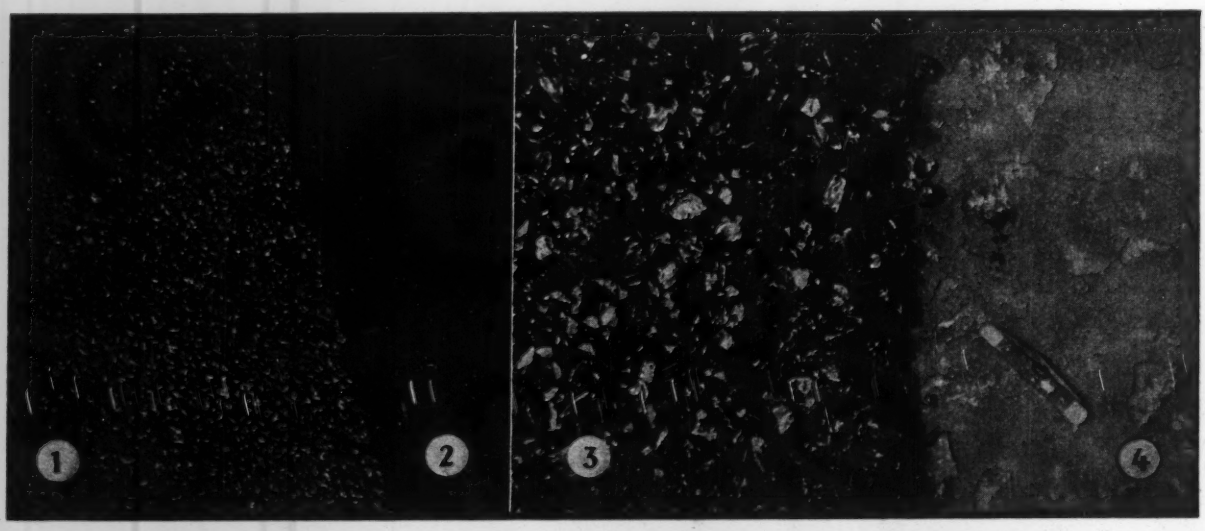


Fig. 3. How the runway surfaces appear at various construction stages: (1) Fine stone seal, (2) wearing course, (3) binder course, and (4) knapped stone base sealed with screenings.

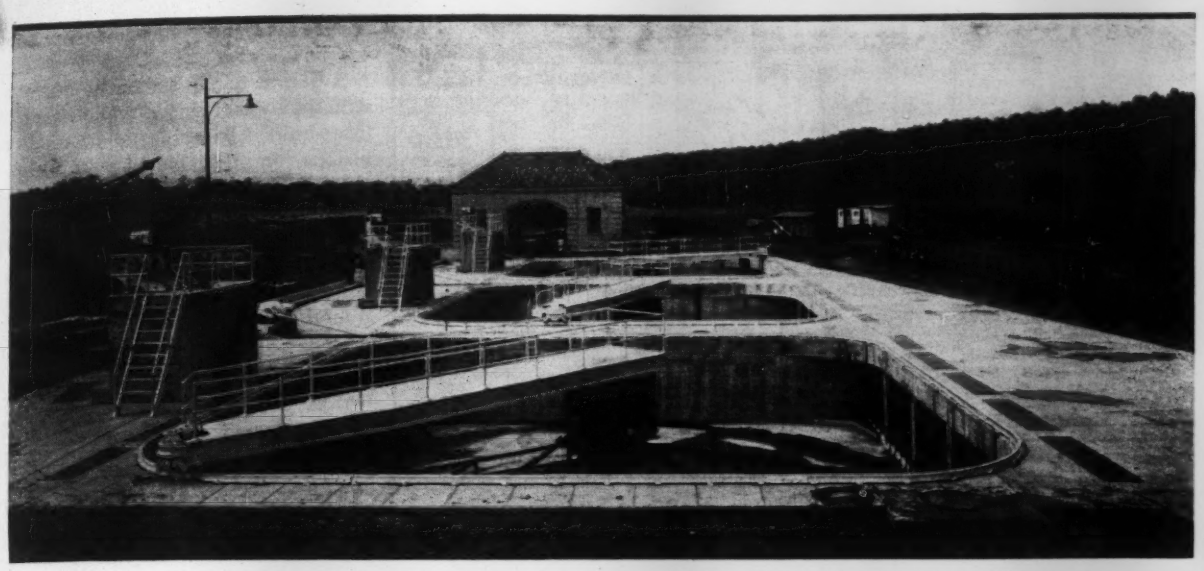


FIG. 1. DETRITORS WHICH WILL REMOVE, WASH AND DRAIN GRIT FROM A FLOW UP TO 300 M.G.D.

Baltimore Modernizes Its Sewage Plant

E. J. CLEARY

Assistant Editor, Engineering News-Record, New York.

Contents in Brief—Always alert in keeping up its public service facilities, Baltimore has practically completed major renovation of the famous Back River sewage disposal works. A $4,000,000 improvement program has given 1939 efficiency to a plant designed in 1907.

Of particular interest is the installation of sludge elutriation facilities —one of the relatively new developments in treatment practice—and vacuum filtration equipment. Other improvements include grit chambers, mechanically-cleaned bar screens and sedimentation tanks, and new sludge digestion facilities.

Still functioning in good order is the hydro-electric generating plant, the water wheels of which are operated by the purified sewage effluent. Power production as a by-product of treatment is an old story to Baltimore.

A GREAT DEAL can happen when a $4,000,000 improvement program is undertaken at a sewage disposal plant as it has been at Baltimore. The famous trickling-filter, separate sludge digestion plant at Back River, construction on which was started in 1907, has undergone major renovation in the past six years. The additions include the installation of mechanically-cleaned bar screens and shredders, new clarification tanks, additional digestion tanks and facilities for the elutriation and vacuum filtration of sludge. Entirely separate from these improvements is the addition of a complete activated-sludge plant with a capacity of 20 m.g.d., construction of which has just begun.

Observers of change in the practice of sewage treatment can see at the Baltimore plant an interesting picture of progress in the last quarter century. This is particularly evident in the adaptation of mechanical aids to treatment processes. The contrast of old and new is strikingly exhibited in the case of clarification facilities. When the Back River plant was placed in operation in 1911, the huge rectangular sedimentation tanks (103 ft. wide, 420 ft. long, and 14 ft. deep) had to be taken out of service every few weeks so that the sludge deposits could be manually removed with squeegee and hose. These tanks have now been supplanted by circular units fitted with mechanisms which not only continuously remove settled solids without disturbing operations, but remove scum from the surface of the tank as well.

Facilities for screening sewage likewise distinguish modern practice from that of the past. The old bar-screen gallery where laborious and unpleasant hand-raking operations were conducted is now supplanted by a battery of mechanically-cleaned screens. Automatically controlled, they collect debris which is then shredded and returned to the flow—no clogging troubles, no odors and no messy operations.

And finally, to take the place of 13 acres of sludge drying beds whose usefulness depended on the vagaries of the weather, there are now vacuum filter machines which will dewater

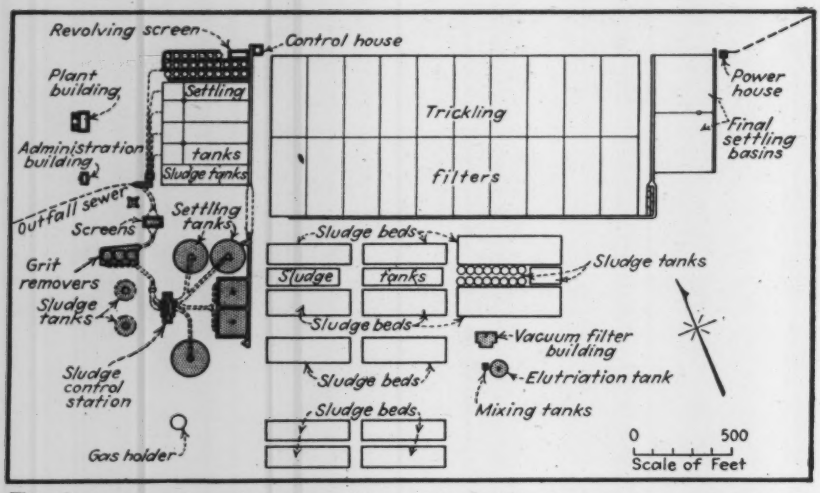


Fig. 2. General layout of the Baltimore plant. The shaded areas are the new facilities added to the old plant built 30 years ago.

sludge in rain or shine. And the space they occupy with accessories is considerably less than a quarter of an acre.

But all that is old is not outmoded. Despite the changes that have taken place, the original trickling filter installation (30 acres in extent) functions just as splendidly now as when it was first built. Instead of showing signs of obsolescence, the performance of this rugged oxidation device gives increasing evidence as the years go by that its usefulness and efficiency grow with the passage of time. Except for a few minor repairs in the distribution nozzles, nothing has been or needs to be done to the filters.

General impressions

There is an air of spaciousness and rural beauty about the Back River works which few other sewage disposal plants possess. It is situated far on the outskirts of the city, and it occupies part of a wooded site some 550 acres in area. To reach the administration building from the highway you skim along a tree-lined concrete road, surrounded by shrubbed areas and well-kept lawns. Three decades of thoughtful care have converted the plant grounds into a well-groomed park.

A tour of inspection was made in the company of George Armeling, superintendent, and Edward Cromwell, chief chemist of the plant. The first stop was the new screen building which houses three mechanically-cleaned screens. One of these is a standby unit and the other two accommodate the average daily flow of 87,000,000 gallons. All the material retained on the $\frac{3}{4}$-in. screen openings is shredded and returned to the sewage flow.

Adjacent to the screen house, construction was being completed on a three-unit detritor installation. Provisions for grit removal were not included when the Back River plant was originally built. The city had a separate sanitary sewer system and it was expected that little grit would be present in the sewage. That a considerable amount of grit finds its way to the plant, however, is evidenced by deposits in the sludge digestion tank. Consequently, grit removal facilities in three concrete tanks each 50x50x9 ft. in depth, were included in the improvement program.

Already in operation are four new primary sedimentation tanks, all of which are fitted with rotating sludge scrapers. Two of these, completed in 1931, are 140x140x15-ft. deep, and they each have a capacity of 2.15 million gallons. The other two tanks, which were just recently placed in operation, are 170 ft. in diameter and 14.5 ft. deep; they each have a capacity of 2.5 m.g. Construction of a fifth clarifier of the same size will soon be completed. The addition of these facilities has made possible the abandonment of the huge rectangular settling basins, which required cleaning by hand.

Fine screens for solids

Despite the replacement and increased capacity of sedimentation facilities, continued use will be made of the fine screens through which settled sewage is passed before it goes to the trickling filters. These screens are highly effective in removing solids from clarified sewage which might otherwise clog the filter nozzles. They are of the revolving drum type, 12 ft. in diameter and 10 ft. long, covered with 20x20 mesh monel wire cloth. Five units are available for use. The solids removed by the screen are discharged to some old Imhoff tanks, long out of use.

A splendid view of the 30 acres of filter beds was had from the control tower, and from here the inspection was continued by driving a mile or more to the final settling tanks. The filter bed, incidentally, is $8\frac{1}{2}$ ft. deep and is filled with $2\frac{1}{2}$ in. trap rock. The distribution nozzles are spaced 15 ft. center to center, and the beds are dosed at the rate of 3 m.g. per day per acre.

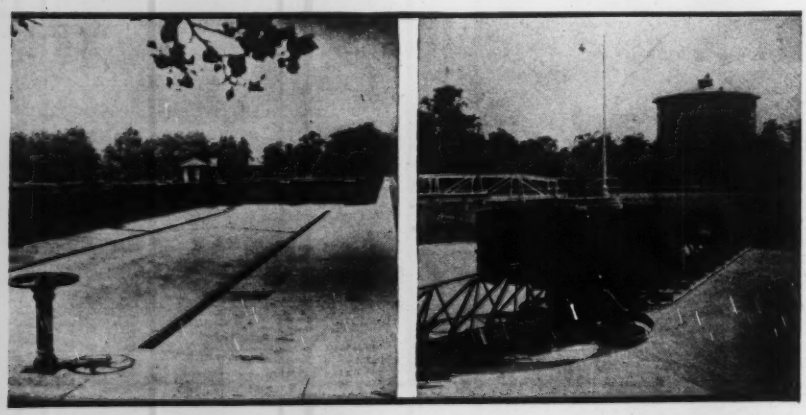


Fig. 3. Old and new in sedimentation basins. The rectangular tanks on the left built in 1911 are 420 ft. long and required manual cleaning; the new circular clarifiers are 170 ft. dia. and are equipped with mechanical sludge removers.

The final settling tanks are huge affairs which look like small lakes. There are two adjoining tanks, each 291x277x11-ft. deep and they furnish a detention period of 3.5 hours; sludge is removed twice a year. The manner in which the tank overflow is brought over a spillway to a central point of discharge where it drops several feet to the outfall sewer makes it appear that this might be a hydroelectric project. And, in fact, it is. The effluent from the tank cascades into a well where it operates two waterwheels. These are connected with generators of 100 kw. capacity and enough power is produced to operate a large part of the disposal works.

The plant effluent after passing through the waterwheels, is discharged into Back River through two 60-in. wood stave conduits that are carried out some 2,500 ft. from the shore. At the edge of the river a discharge chamber has been built over the pipe line, which acts as a relief overflow. It is at this point that the visitor receives convincing evidence of the high quality of the plant effluent. Fishing enthusiasts gather here to make their best catches—and they are not after catfish, either!

As was stated earlier, the layout and the physical dimensions of the Baltimore plant leave you with a sense of bigness. There are a number of disposal plants in this country which are greater in treatment capacity but few of them look larger or more impressive. Take the sludge digestion facilities, for instance. Fifty-one tanks are in use, and they have a total storage capacity of 3,128,000 cu.ft! The drying beds, adjoining the tanks, cover about 13 acres, and they receive two applications of sludge yearly.

Not seen because they are underground are two recently completed digestion tanks, each 100 ft. in diameter and 25 ft. deep. These are heated units and provided with stirring mechanisms. A third digester, similar in size, is now under construction. These three units have a total capacity of 600,000 cu.ft.

Nearby these tanks is a new sludge control building which houses pumps, hot water equipment, and facilities for gas recording and distribution. In one wing of the building there are two large wells to which raw and digested sludge can be pumped, either to or from the digesters, to the drying bed or to the vacuum filter building now being completed.

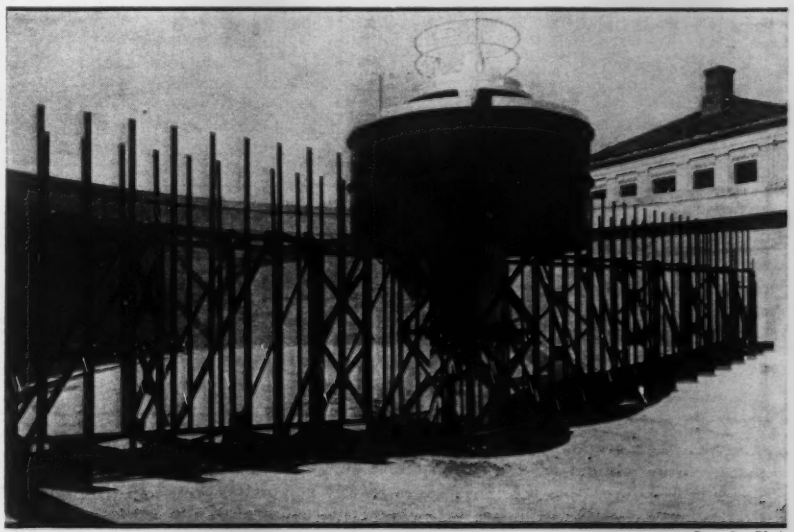
The final addition to the plant under the present improvement program is the installation of sludge elutriation and vacuum filtration facilities. It will be recalled that for a number of years A. L. Genter and members of the staff of the Baltimore Bureau of Sewers have been studying sludge elutriation as an aid to mechanical dewatering. Based on these studies facilities have been built to adopt this process and abandon sludge drying and sand beds.

Work has been completed on the elutriation tank which is 80 ft. in diameter and 15 ft. deep. The tank is equipped with a "picket fence" stirring mechanism to agitate the sludge as it is being washed. In the filter building have been installed two vacuum dewatering units, each with drums 11.5 ft. in diameter and 14 ft. long which provide an effective filter area of 500 sq.ft. They are designed to continuously filter sludge at a rate of 6 to 8 lb. per sq.ft. per hour, reducing it from 95 to 75 per cent moisture content. Equipment has been provided for conditioning the sludge with chlorinated copperas prior to dewatering.

No visitor to the Back River plant is permitted to leave without having first signed the guest register. Fulfilling this pleasant obligation, one feels a sense of special privilege, particularly if time is taken to glance back through the pages of the book. In it are recorded the signatures of the great, the near great, and just plain folks in the field of sanitary engineering and allied sciences, some of whom have traveled from the far corners of the globe to see the world-famous Baltimore sewage disposal facilities.

Fig. 4. George Armeling, superintendent, and Edward Cromwell, chief chemist.

Inspection of the Baltimore plant was made through the courtesy of the Department of Public Works, of which Frank K. Duncan is chief engineer. Plant design, construction and operation are under the direction of the Bureau of Sewers of which George E. Finck is sewerage engineer and C. E. Keefer, associate engineer. George Armeling is superintendent of the plant and Edward C. Cromwell is chief chemist.



Dorr Co. Photo

Fig. 6. "Picket fence" thickener in the 80 ft. dia. sludge elutriation tank.

New Bearings for an Old Bridge

How the heavy trusses of the Manchester Bridge at Pittsburgh were lifted to insert modern rockers in place of badly damaged ones

TWENTY YEARS AGO when the Manchester Bridge, which crosses the Allegheny River at the "Point" in Pittsburgh, Pa. with two 531-ft. simple truss spans, was about 15 years old, the four expansion bearings on the center pier (two for each span) underwent extensive repair, following failure of one of the rockers. Last summer, after inspection disclosed that some of the rockers had turned completely over and that other serious damage had occurred, a second repair job was undertaken that involved installation of new bearings under each of the four shoes. An effective lifting arrangement, designed by H. S. Ayers, senior designing engineer of the city bridge department, and built and operated by the contractor, Eichleay Engineering Corp. (Charles Welty, Jr., construction foreman), was used to insert the bearings without disturbing traffic. The cost of the job illustrated here was $31,908.

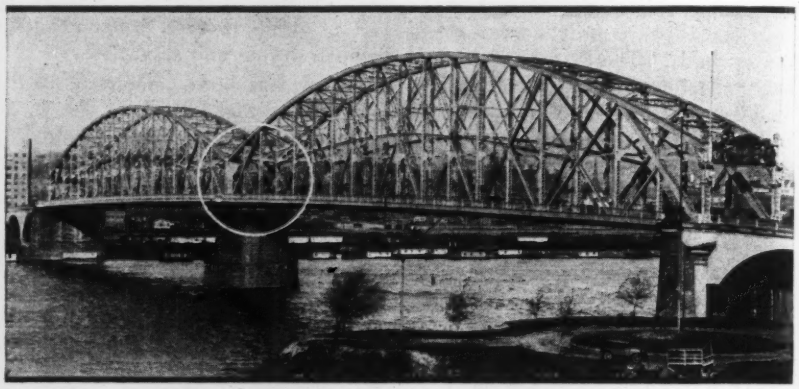


Fig. 1. Manchester Bridge, Pittsburgh. Expansion bearings for both spans are on center pier, the scene of the construction operations illustrated herewith.

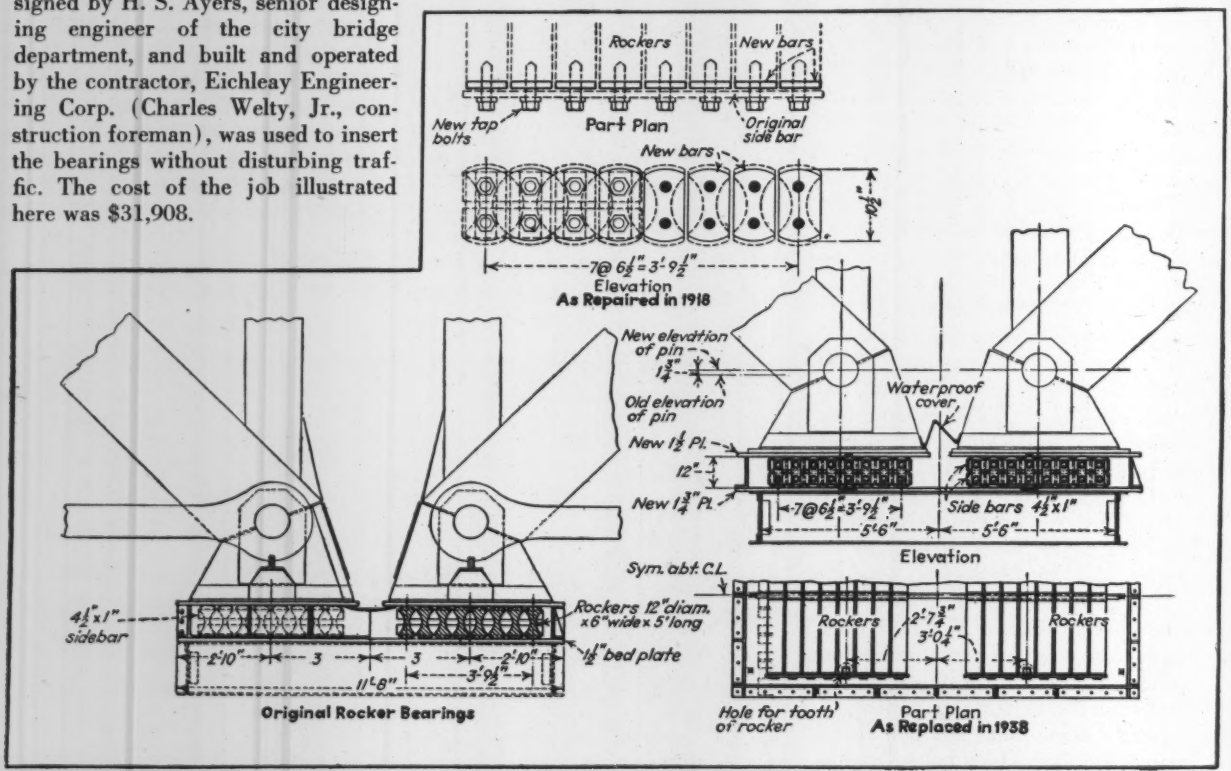


Fig. 2. The original rocker bearings, inclosed in grease boxes, were steel castings of such shape that it was possible for them to turn over without binding against one another; breakage of some of the side bars, when ice prevented expansion movement, did permit some of the rockers to fall completely flat. In the 1918 repair, small plates were inserted behind the side bars in an unsuccessful attempt to prevent the collapse of the rockers. In the 1938 replacement, rolled steel rockers are used, of a shape that will bear laterally against one another before rocking beyond the point of effective bearing. Also, toothed bars attached to the rockers engage holes in the new bearing plates.

Fig. 3. Inspection in 1938 revealed some of the rockers lying flat as shown.

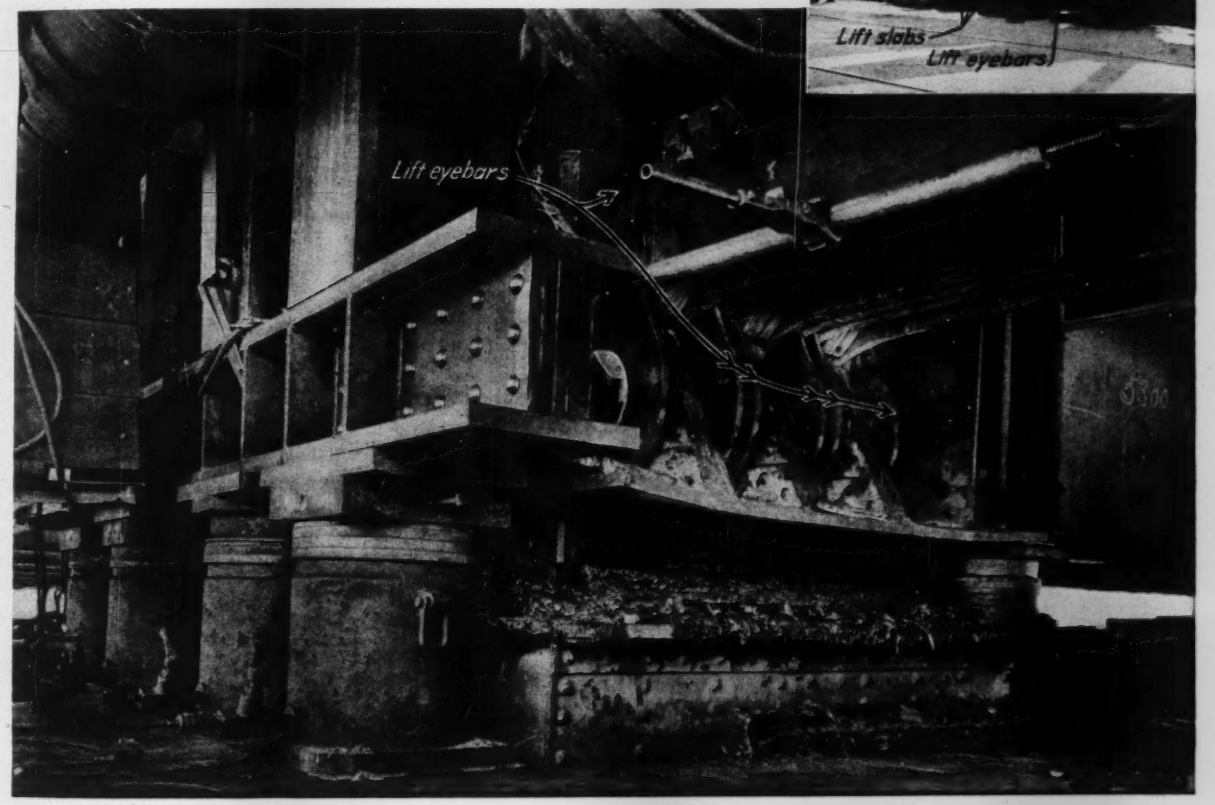


Fig. 4. The lifting arrangement for one side, i.e., to lift two shoes (one for each span) simultaneously, included eight 500-ton hydraulic jacks resting on four 7¼-in. slabs, 20 in. wide and 5 ft. long, placed on the bridge pier. An equalizing beam over each two jacks carried two columns. Each column supported one end of a solid slab lifting beam immediately above the roadway, as shown in the upper view. Each of these lifting beams served as the top "pin" connection for six alloy steel eyebars connected at their lower ends to 8-in. dia. pins in holes bored in the bridge shoes. By raising the jacks, the trusses were lifted by their shoes permitting replacement of the bearings.

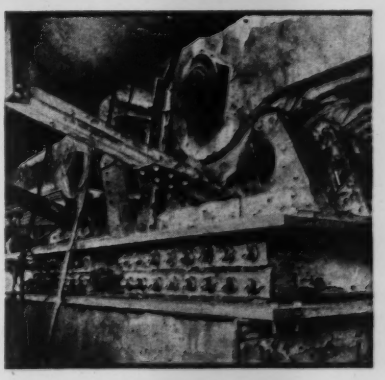


Fig. 5. New rockers between new bearing plates, and ready for installation of inclosing grease box.

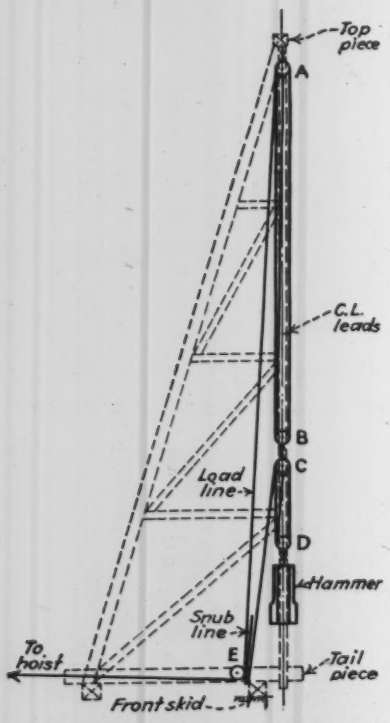
Novel Drop Hammer Rig

. E. NEIL W. LANE .

Nebraska Department of Roads and Irrigation, Lincoln, Neb.

WHILE driving steel tubes for the foundation of a bridge, it became desirable to change the drop-hammer pile driver so as to obtain the short rapid blows of a steam hammer better to drive the tubes through a layer of quicksand. The number of steel tubes remaining to be driven was small and would not warrant the expense of shipping a steam hammer to finish the job. To overcome this difficulty, the gravity hammer rigging was changed to that shown in the accompanying illustration, which shows the starting position of the new rigging with the lower load or snub line fastened around the tailpiece. The snub line is shown in this position to avoid confusion in showing two lines going to the hoist.

The new rigging consists essentially of two sets of double pulley blocks hooked in series, with the upper blocks A and B pulled apart as far as possible and the lower blocks C and D drawn fairly close together. The lower block D is hooked directly into the hammer and the upper block A is fastened to the top piece. The load line from the upper block runs through one pulley of a double block E at the front skid and from there to the drum of the hoist. The snub line is either snubbed around the tailpiece on one side or run through the remaining pulley of the double block E. and snubbed around the nigger-head of the hoist.



Drop-hammer pile driver rigged to strike short quick blows for penetrating quicksand

To operate this rig the end of the snub line is held by a laborer, with the free end of the rope strung out behind him, so that there will be no chance for the rope to catch on anything or to become snarled. The hoist supplies an even and continuous pull on the upper load line while the snub line is held tight. As the hammer is thus raised a few feet, the lower blocks C and D are pulled nearly together at which time the laborer releases his snub on the nigger head. The hammer falls and the laborer tightens his snub line again, thus picking up the hammer and starting the next blow. The snub line is thus alternately tightened and released, giving a series of short but rapid blows, until the hoist has pulled the top set of blocks nearly together. This completes one series of blows, usually ten to twenty, depending on the height of pile driver and average drop of the hammer for each blow.

To start again it is only necessary to release the break on the upper load line and pull the upper blocks apart with the snub line to return the blocks to their original position; the process is then repeated as before. After the first blow in each series, the lower blocks are not pulled completely together before releasing the snub line, as this will cause an increase in the drop and in the time between blows with each drop of the hammer. After a little experimenting the most desirable fall is determined for the particular condition of driving and this drop is afterward maintained.

The equipment is commonplace and cheap, but it is effective for the purpose of supplying a series of short rapid blows. The rigging was described to me by Ross C. Gore, project engineer for the Nebraska department of roads and irrigation.

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Houston Highway Committee Gets Results

The Houston, Tex., Chamber of Commerce has an active highway committee that gets results, according to the annual report of the association, just released. A committee of 43, headed by W. P. Hobby, cooperates with city, state and neighboring county and community highway authorities in a constant effort to improve and increase the highway facilities in the Houston trading area, which seems to cover the entire southeastern part of the state. The committee is also interested in the Laredo-Mexico City highway and the Pan American highway leading to South America.

During 1938 the committee was actively interested in pushing projects on twelve state routes in the vicinity of Houston. It was instrumental, according to the report, in having these routes widened and paved at certain points, grade crossings eliminated, by-passes established and new routes projected. After planning its program, the committee goes to each community affected, and together they work out projects for consideration of the state highway department. Such concerted action by groups of communities seems to be highly effective.

In an appreciation of the necessity of a close understanding with state highway officials, the committee held a dinner meeting attended by 400 engineers, officials and others interested in roadbuilding. Another dinner was held in honor of Jas. Douglas at his termination of 12 years of service as state highway department district engineer at Houston. The report states that the new district engineer, W. J. Van London "has already endeared himself to members of the committee and has shown a decided disposition to cooperate."

Notes on Sewage Disposal

A monthly summary of current developments conducted by Willem Rudolfs

TRICKLING FILTER LOADINGS—The load applied to a trickling filter depends upon the amount of soluble and insoluble materials present. The purification with a given loading depends upon the length of time these materials are retained in the beds. In general, the smaller the loading the higher the degree of purification. Septic sewage with much soluble material or a high biochemical oxygen demand requires a longer contact time than fresh sewage and has a greater "immediate" oxygen requirement. There is, then, a certain limit of application which determines the degree of purification. This limit is changed when the amount of soluble material is augmented by the liquefaction of sludge particles deposited on the stones.

According to Ponninger (*Gesundheits Ingenieur* 599, 1938) this limit can be extended either by intermittent rest periods or by supplying more oxygen. He found that when small stones are used the quantities of suspended solids retained in the bed increase so that not only does clogging occur, but with it increased liquefaction and a reduction in purification. Experience in this country has shown that with weak sewage small stones produce a higher degree of purification while with strong sewage there is apt to be clogging and the eventual production of a poor effluent.

SLUDGE DENSITY—Successful activated sludge treatment calls for the production of a sludge which settles readily and compacts easily. The literature reports a large number of instances in which this has proven very difficult or impossible. Abbott (*Annual Report*, Shanghai Municipal Council, 1937) reports that the most serious and persistent loss of these desirable sludge properties began at his plant in 1936 when settled sewage was substituted for raw sewage in the aeration units. A search was made both on plant and laboratory scale for a silt or mud which could be incorporated in the sludge and thereby increase its density. In a number of cases partial success was attained, but finally the attempt was abandoned. Temporary benefits from additions of road dust and soil have been obtained at some plants.

FUNGUS GROWTH—Large quantities of gray and brown slimy clumps of fungus in the raw sewage appear at many Illinois sewage treatment plants after the first heavy spring rain. According to the state department of public health, winter conditions in the sewers are favorable to the growth of this fungus, which comes loose quite suddenly in the early spring. When this trouble occurs, the remedy is to spend extra time in cleaning screens and skimming primary tanks so as to prevent passage of the fungus to trickling filters (where it plugs distributors and causes pooling), or to aeration tanks, where it may overcome more desirable forms of bacterial life.

PHENOL WASTES—Soil bacteria capable of destroying poisons such as arsenic may be a blessing or a nuisance depending upon when and where they do their work. For years bacteria which attack phenol (carbolic acid) have been a boon to water treatment plants receiving wastes from certain industries. Bacteria have been used in Emscher filters for the purification of phenol wastes for a number of years, especially in Germany. These treatment plants were rather small and it was considered that sewage was necessary to supply some food ingredients and sufficient bacteria of the proper type.

After considerable experimentation the Dow Chemical Co. at Midland, Mich., producing large quantities of phenolic wastes, has constructed a plant treating 13 m.g.d. which appears to have an unusually high efficiency. The strong waste, says *The Dow Chemical* (Aug. 1938) is stored in ponds, neutralized with lime and then mixed with weak waste. This mixture is next put through a clarifier, after which the supernatant is oxidized on trickling filters and passed into two large ponds. The effluent from the ponds is aerated over a spillway for releasing odors and adding oxygen to the water. The bacteria present aid further purification in the river.

The soil organism principally responsible for purification is *Achromobacter Cruciviae*, but half a dozen others present play a minor role. The 0.5 m.g. of storage waste plus the 12.5 m.g. of weak waste contains about 2,000 pounds of phenol. This is reduced in the trickling filters to about 200 pounds, in the first pond to about 10 pounds and in the final effluent to 0.5 ppm. or less. This is the first time that such a large volume of phenol wastes have been treated successfully. No domestic sewage is needed to supply or maintain the specific types of bacteria.

SLUDGE BULKING—Bulking of activated sludge may be caused by a variety of conditions. During dry weather more difficulties are experienced than during wet weather. This has been ascribed to increased strength of sewage, more stale sewage, decrease in dissolved oxygen in influent, etc. During drought conditions the activated sludge in Manchester (Rivers Dept. *Report* 1938) became very light and settled with difficulty, although no unusual quantities of suspended matter passed the weirs. In this case examinations showed that the "bulking" was not due to change in pH values, lack or excess of oxygen in solution, the presence of filamentous growths or excessive amounts of grease, but appeared to be due to the normal decrease in density experienced during dry weather, together with a lowering of the critical weight of the sludge.

The lowering of the critical weight is believed to be a physical process, dependent upon the nature and concentration of the trade wastes in the sewage. It is suggested that the normal volume of return sludge must be reduced. It is possible that good results reported occasionally in this country by addition of inert materials is the result of weighting down such light fluffy sludge produced during prolonged dry weather.

FROM FIELD AND OFFICE

Working problems and time-saving methods . . . Edited by Charles S. Hill

Portable Shanty and Tool Shed

NEAL B. MITCHELL
Engineering Department,
City of Salem, Mass.

The portable shanty illustrated is a time saving item to any public-works department. It is 10x8x8 ft. and although only a shanty and tool shed the building is constructed to be as dry and warm as possible, while requiring little more material than usually is used in such structures.

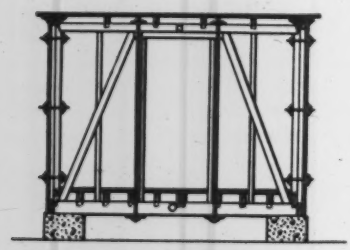
The safe floor load is 8,000 lb., uniformly distributed. The sides are attached by bolts to the front, back and roof sections, and the floor is carried on the lower chords of the trusses. The front and rear wall plate and sill are held, at their centers, against the rafters and floor joists by ½ in. steel tie rods. The shanty is held off the ground by four concrete building blocks, one at each corner, as shown in the perspective view.

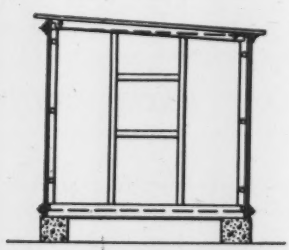
Trussing the front panel gives it needed stiffness.

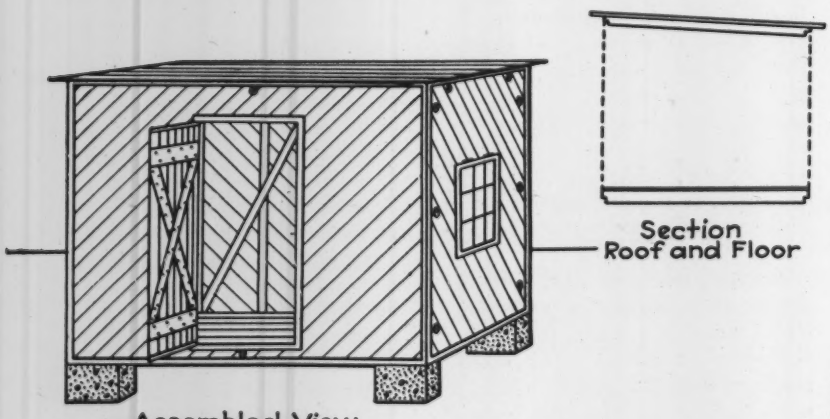
The entire structure is so fabricated that it requires but three or four men to dismember, transport and reassemble it, the heaviest section weighing only 230 lb. The floor is in two sections, split at the double floor joist, as shown in the front frame elevation. The door and windows are detachable. The total cost of materials is less than $70. It is recommended that wooden shutters be provided for the windows.

MATERIALS REQUIRED

Roof, ⅞-in. matched boards covered with composition roofing material.
Rafters, 2x4-in. spruce spaced 24 in. c. to c. and notched on ends to fit on and against wall plate.
Wall plate, 2x4-in. spruce.
Truss, 2x4-in. spruce compression members.
½-in. steel tension rods.
3x2x⅛-in. steel bearing plates.
Studs, 2x3-in. spruce.
Flooring, ⅞-in. matched boards.
Floor joists, 2x6-in. spruce spaced 12 in. c. to c. and notched on ends to fit on and against the sill.
Sill, 2x6-in. spruce.
Siding, ⅞-in. matched boards applied diagonally.
Tie rods, ½-in. steel.





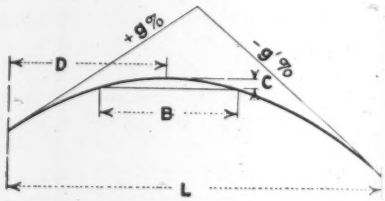


Portable shanty and tool shed used by the Salem, Mass., water department

Bridge Camber On Crest

C. B. COE
Assistant Highway Engineer,
Tennessee Valley Authority,
Chattanooga, Tenn.

Frequently in highway design, a bridge is located at the summit of a vertical curve. In this case, to satisfy the requirements of easy riding and appearance, the bridge lines should follow as closely as practicable the lines of the vertical curve, and to do



Calculating bridge camber on vertical curves

this the camber at the center must be known. The camber is computed by the formula:

$$C = \frac{B\,(g - g')}{800L}$$

where

C=camber in feet
B=span of bridge in feet
g-g'=algebraic difference of the gradients in per cent
L=length of vertical curve

This formula gives only approximate results when the two gradients are not equal, but is sufficiently accurate within the limits usually encountered.

It may also happen that for various reasons the camber and span of the bridge is fixed, whereupon it devolves upon the designer to plan his curve and gradients accordingly. Then the center station of the bridge is located from the *PVC or PVT*, or vice versa by the formula

$$D = \frac{Lg}{g - g}$$

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Getting Accurate Bearings

EPHRAIM SOLKOFF
Rodman, New Jersey State Highway
Department, Jersey City, N. J.

In surveying, it is often desired to determine the bearing of courses closer than the magnetic box of a transit permits. This can be accomplished by a method used while I

was with the U. S. Forest Service, in the mapping of the Ocala National Forest.

Each traverse began at a Coast & Geodetic triangulation station, with the line from it to one of their reference points as the initial course. The azimuth of this line was secured from the Coast & Geodetic notes.

The transitman set up over the reference point, and set the given azimuth on the horizontal plate. He then sighted on the triangulation point with his telescope reversed, then he loosened the upper plate and plunged his telescope right side up. The lower plate was then in true relation with a compass, its zero being coincident with true north (or south if the given azimuth was from south). The transitman then sighted on his own station placed ahead and clamped his upper plate. The reading on the horizontal plate is the true bearing or azimuth (as desired) of the projected line.

The transitman then sets up on his new station, sets the new azimuth reading on his plate, keeping the two plates clamped. He loosens the lower plate clamp, sights on his previous "set-up" station, with telescope reversed, and tightens the lower clamp. He loosens the upper plate clamp, plunges his telescope forward, and is all set to determine the azimuth of his next course. The compass box is ignored, except as a check against mistakes in reading.

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Regulating Centrifugal Pump Discharge

K. B. HUMPHREY
Sayreville, N. J.

On many excavating jobs where dewatering is necessary, the pump is too large when the bulk of the water has once been removed, but is none too large when it is necessary to get the work under way in a hurry. The standard centrifugal pump, with a foot valve and bucket priming, may be throttled so that the discharge will coincide with the amount of water to be pumped. Perhaps the best way is to use a valve of the correct size on the discharge line but a simple throttling device can be rigged by using a discharge pipe with a flanged end. A piece of plank is bolted across the flange so that the discharge is cut down to the desired degree. With a trial or so the discharge can be regulated closely enough for ordinary work.

Another way in which the discharge of a centrifugal pump may be regulated is by changing the speed. In an electrically driven pump this is impossible without using a variable speed motor which is expensive and, as a rule, not available on a construction job. When the pump is driven by a gasoline engine the speed may be easily reduced so that the correct discharge will be obtained. It is much more efficient to reduce the speed and it is always best to regulate the discharge by changing speed. However, in many cases a change in speed is not practicable while the simple method of throttling can be done at any time. In most cases too a dewatering job does not require efficiency so much as ability to get the pumping done quickly.

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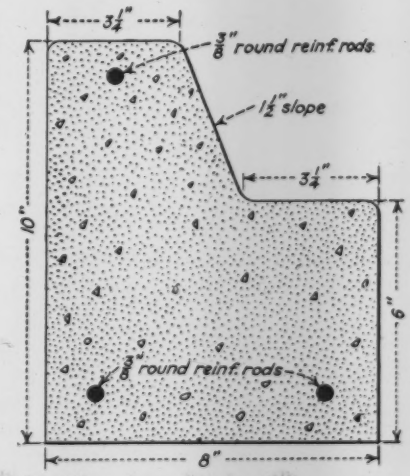
A Cheap Street Curb

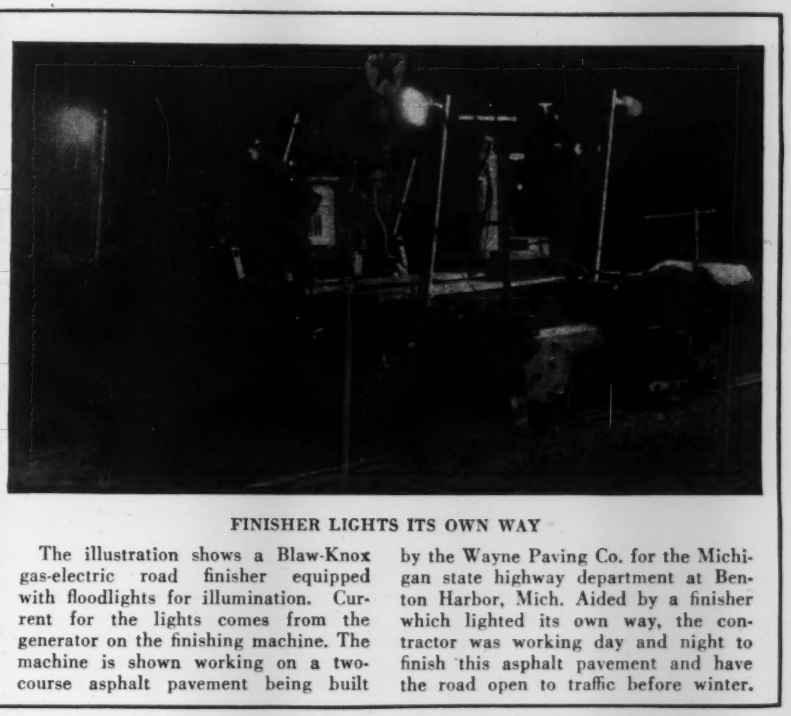
ARTHUR J. JOHNSON
City Engineer, Red Oak, Ia.

The curb section illustrated has proved an important factor in low-cost street improvement in Red Oak, Iowa. With WPA labor the city is furnishing a finished street at a cost of $25 for each 45-ft. frontage. This includes curbing, a clay-bound gravel base, and a bituminous surface composed of a primer coat, two binder courses, and a seal coat using crushed limestone, passing a ½-in. screen and retained on a $\frac{3}{16}$-in. screen as aggregate for the wearing surface.

As shown, the curb section is 10 in. deep on the back, 8 in. wide on the bottom, 6 in. thick on the toe of the gutter with a curb having a section 3¼ in. wide at the top, 4¾ in. wide at the bottom with a 3¼-in. gutter at grade line. In this section are placed three ⅜-in. round steel rods, the section forming the likeness of a



Special curb section for low-cost streets



FINISHER LIGHTS ITS OWN WAY

The illustration shows a Blaw-Knox gas-electric road finisher equipped with floodlights for illumination. Current for the lights comes from the generator on the finishing machine. The machine is shown working on a two-course asphalt pavement being built by the Wayne Paving Co. for the Michigan state highway department at Benton Harbor, Mich. Aided by a finisher which lighted its own way, the contractor was working day and night to finish this asphalt pavement and have the road open to traffic before winter.

standard angle. The city has built about 3,000 ft. of this section on the beginning of a project that may be five miles before the work is complete. With a section as small as this, the cost in many localities is so low that even the streets where 25 per cent of the lots are vacant can become improved streets.

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Scheduling Stair Steel

W. C. GOODWIN
Truscon Steel Co., Boston, Mass.

The following formulas have been found useful when scheduling reinforcing bars for concrete stairs.

Results by the formulas can be obtained quicker and more accurately than by drawing large scale details, and more efficiently than by computing many small individual triangles.

All values can be determined and operations performed by slide rule with more precision than is necessary.

Referring to Fig. 1: ϕ = slope angle; s = slab thickness; c = clearance; T = tread and R = riser. The formulas are:

$$k = \frac{s-c}{\sin \Phi} + \frac{R-c}{\tan \Phi}$$

$$l = \frac{c}{\sin \Phi} + \frac{R-s+c}{\tan \Phi}$$

$$m = \frac{s-c}{\sin \Phi} - \frac{s-c}{\tan \Phi}$$

$$n = \frac{s-2c}{\tan \Phi}$$

$$o = \frac{s-2c}{\sin \Phi}$$

$$1+n = \frac{c}{\sin \Phi} + \frac{R-c}{\tan \Phi}$$

$$m+n = \frac{s-c}{\sin \Phi} - \frac{c}{\tan \Phi}$$

Referring to Fig. 2 a sample calculation follows. The values obtained provide enough information completely to detail all the bars shown.

$s = 5$ in., $C = 1$ in., $T = 10$ in., $R = 7$ in.

$\tan \Phi = \frac{7}{10} = .70$ $\sin^* \Phi = .57$

$$k = \frac{5-1}{.57} + \frac{7-1}{.70} = 7.0 + 8.5 = 15\tfrac{1}{2} \text{ in.}$$

$$l = \frac{1}{.57} + \frac{7-5+1}{.70} = 1.7 + 4.3 = 6 \text{ in.}$$

$$m = \frac{5-1}{.57} - \frac{5-1}{.70} = 7.0 - 5.7 = 1\tfrac{1}{4} \text{ in.}$$

$$m+n = \frac{5-1}{.57} - \frac{1}{.70} = 7.0 - 1.4 = 5\tfrac{1}{2} \text{ in.}$$

* Read directly from slide rule.

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Level Rod Used as Stadia

OTTO E. STEPHENSON
Town Engineer, Cape Elizabeth, Me.

In the days of railroad building in the West we were often required to locate a river bank or the toe of a mountain or a building from a station on our center line. As we did not carry a stadia rod we used a level rod. The rodman would pick his point and invert the rod, the instrumentman would then set his top wire on the top of the rod inverted and then set the target on the lower wire. The rodman would then call off or signal the reading and the instrumentman would record it with the deflection and vertical angle. If the distance was long or the foot of the rod was obstructed by brush the instrumentman would set his top wire cutting the foot of the inverted rod and then set the target on the center wire. If the elevations of the points were required he would take the height of instrument from the station he was set on and it was very simple to work out the elevations. This method is very simple and rapid and gives very close results for plotting. There is nothing new about this method, but I have not seen it used in the East. I have used it many times on highway work and route surveys.

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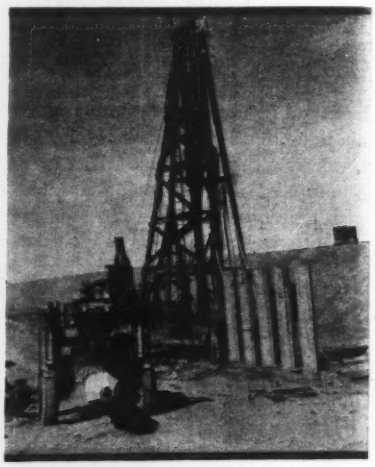


CAMERA MEMORANDA

The familiar lumber truck that straddles a timber or a pile of boards picks it up and carries it suspended is used as shown to carry precast concrete piles for work on the All-American Canal in California.

Solution of a Curve Problem

E. J. CONNELL
Res. Engr. Division of Grazing, Kline, Colo.

Frequently, when re-running center line of railroad or highway, it is found that the original P.C. and P.T. have been disturbed or lost, the P.I. is inaccessible and the P.C. is not visible from P.T. It is known that the sum of the chord deflections

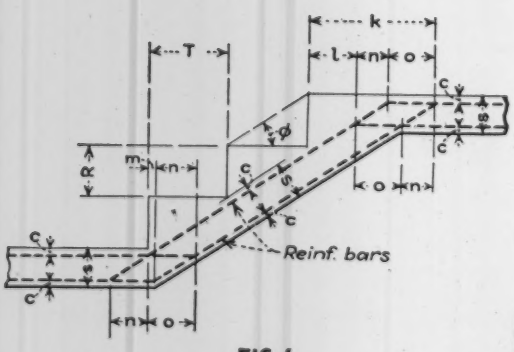


FIG. 1

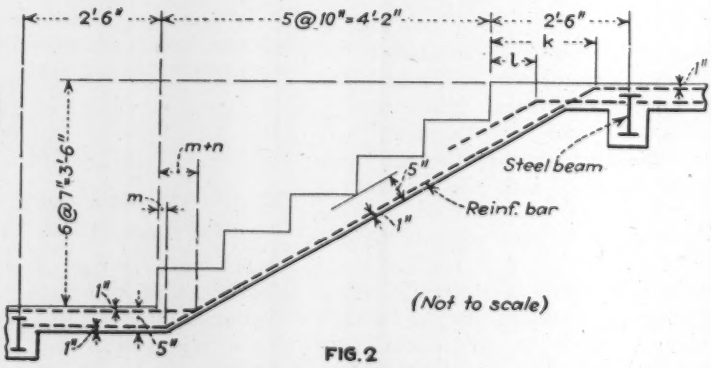
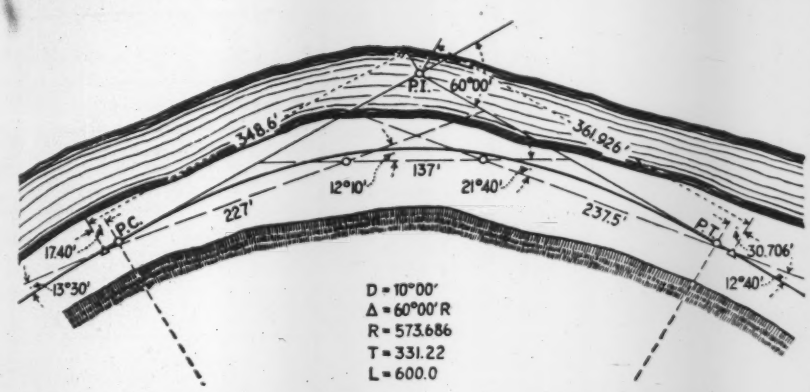


FIG. 2

Diagrams explaining formulas and calculations for stair steel.



equals the intersection angle, but the mathematics of the problem, as usually solved, is tedious. The following method reduces the work:

Set up on the back tangent, as near to P.C. as can be judged by inspection; run a traverse to intersect the forward tangent near to, but just ahead of, the P.T. turn deflections and chain chords very carefully. The solution of the problem is as follows;

Add the following quantities:

sine of 1st defl. times length of 1st. chord.

sine of sum of 1st. and 2nd. defl. times length of 2nd. chord.

sine of sum of 1st., 2nd., & 3d. defl. times lgth. of 3d. chord.

Continue for as many chords as required. The sum of these products divided by the sine of the sum of the deflections will give the distance from P.I. to the point intersected on the forward tangent. Subtract length of semi-tangent from distance thus obtained and set the P.T. To locate the P.C., begin at the opposite end of the traverse and repeat the process. Example for sketch:

sine 13°30′ = .23345 x 227 = 52.99315
sine 25°40′ = .43313 x 137 = 59.33881
sine 47°20′ = .73531 x 237.5 = 201.10728

1st defl. 13°30′
2nd defl. 12°10′
3d defl. 21°40′
4th defl. 12°40′

60°00′ 313.43924

sine 60°00′ = .86603

$\frac{313.4392}{.86603} = 361.926 =$ distance from P.I. to point intersected on forward tangent.

sine 12°40′ = .21928 x 273.5 = 59.97308
sine 34°20′ = .56401 x 137 = 77.26937
sine 46°30′ = .72537 x 227 = 164.65899

1st defl. 12°40′
2nd defl. 21°40′
3d defl. 12°10′
4th defl. 13°30′

sine 60°00′ = .86603 201.90144

$\frac{301.90144}{.86603} = 348.60$ = distance from point of beginning to P.I.

Brief Memoranda

The following simple method can be used in figuring the quantity in any headwall not placed normal to the culvert:

$$V = \frac{A - B}{\text{Cos } \phi}$$

In which V = the desired quantity
A = volume of wall plus the waterway area
B = volume of waterway through a similar wall placed normal to the culvert.
ϕ = angle between the headwall and a normal section.—

BERIAH BROWN, JR., *California Division of Highways, San Luis Obispo, Calif.*

In making test cylinders of concrete, the practice here has been to use a round rod to tamp the concrete into the mold. It has been found that this may cause voids to be left in the concrete (due to arch action) which will reduce its strength. A better form of tamping bar is one with a rectangular cross-section of, say, 1x⅛ in.—GORDON DINSMOOR, *Topeka, Kan.*

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Planimeter Measurements Converted to Acres

HAROLD K. PALMER
Santa Monica, Calif.

In measuring distances on a map the scale of the map is used to reduce inches to feet or miles. Planimeter measurements are area measurements and must be multiplied by a corresponding "area scale," or, if the final values are to be in acres, what might be called the "acre scale", which is the number of acres per square inch. This acre scale is obviously the square of the number of feet per inch on the map divided by 43,560, the number of square feet in an acre, and its derivation requires the use of large figures with a consequent uncertainty in locating the decimal point. The size of the figures can be reduced by changing the scale to chains, and since an acre is 10 square chains, it is only necessary to shift the demical point.

To find the acre scale this way with a slide rule, place 66 on the *C* scale opposite the scale of the map on the *D* scale. The index of the *C* scale will then be opposite the number of chains per inch on the *D* scale, and opposite the index on the *B* scale is found the number of square chains per inch on the *A* scale. The number of acres per square inch will be one tenth of this. Without moving the slide the number of acres will be found on the *A* scale opposite the planimeter reading on the *B* scale.

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Easy Roadside Planting

K. S. ANDERSSON
Fort Mills, Philippine Islands

In road maintenance in the Philippine Islands tropical rains present a problem in erosion. Landslides are frequent and severe. Fortunately, these same tropical rains also furnish the solution to the erosion problem. Sticks of any fast-growing plant are simply cut off and thrust into the ground. In a week or two, they will have rooted and put forth leaves. In only a month or two, the fierce fight for life ever taking place in the tropics will have transformed the bank into a dense, choked mass of small trees—a jungle.

Softwoods, such as Ipil-ipil or cacawate, are the favorites, as these grow rapidly and have roots below the ground about as deep as the height of the tree above the ground.

Cuttings in leaf in two weeks

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

JANUARY construction material prices taken as a whole reflect no major changes from December. Short Leaf Southern Pine is 50c. to $1.00 lower on most sizes in Atlanta and St. Louis; $1.00 lower on 1-in. and 2 x 4-in. in Chicago; $1.00 higher on 1-in. sizes in New York; and $1.00 and $2.00 higher on 2 x 6-in. and 2 x 8-in. sizes in Baltimore. Douglas Fir 3 x 12-in. timbers are off $1.00 in Chicago; and Native Pine 6 x 12-in. timbers are off $4.50 in Denver Long Leaf Yellow Pine 2 x 12-in. timbers are mixed, up $2.00 in Baltimore, $2.50 in New York, and $1.00 in St. Louis, but off $1.50 in Atlanta.

Portland cement is up 12c. per bbl. in Detroit; up 14c. in Minneapolis; but off 5c. in New York. Sand is 15c. per ton higher in Cleveland and Dallas. Ready-mixed concrete is up 50c. per cu. yd. in New York but 10c per cu. yd. lower in Dallas.

Steel prices are steady, with expanded metal lath providing the only change. Lath is $1.00 higher per 100 sq. yd. in Baltimore and Detroit, $2.00 higher in Los Angeles, while it is $1.00 lower in Cleveland.

Structural ironworkers' new rate is $1.80 per hour in Boston, an increase of 30c. over the former wage. Plasterers' wage rate is 5c. per hour higher in San Francisco. Common labor rates remain at their December levels.

CEMENT, AGGREGATES, READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT (Per bbl., carload lots, including 40c per bbl. for bags, cash discount not included)			SAND AND GRAVEL (Per ton, carload lots)			CRUSHED STONE (Per ton, carload lots)		CRUSHED SLAG (Per ton, carload lots, f.o.b. plant)		CONCRETE (Ready Mixed 1:2:4, 50 c.y. or more, delivered)
	Cloth Bags	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.90	$2.65	$2.60	$1.75	$1.85	$1.95	$1.65	$1.75	$1.55	$1.65	$7.75
Baltimore	2.31	2.06	1.91	1.75‡	1.75‡	1.25‡	1.75‡	1.75‡	1.75‡	1.75‡	7.00
Birmingham	2.55	2.30	1.99	1.80	1.80	1.45	1.00	1.00	.90	1.15	5.45
Boston	2.75*b*	2.50*b*	2.30	1.10	1.10	.80	1.10	1.10	....	....	6.75*m*
Chicago	2.60	2.35	2.20	2.00‡*d*	2.00‡*d*	2.00‡*d*	2.00‡*d*	2.00‡*d*	1.25‡	1.25‡	....
Cincinnati	2.47	2.22	2.07	1.20	1.20	1.30	1.80	1.80	....	....	6.60
Cleveland	1.95	1.70	....	1.45*i*	1.45*i*	1.45*i*	1.70*i*	1.70*i*	1.70*i*	1.70*i*	6.65*i*
Dallas	2.30	2.05	1.85	2.00*p*	2.00*p*	1.50*p*	1.69*p*	1.84*p*	....	....	6.40
Denver	3.02	2.77	....	1.20	1.40	.90	....	....	....	....	7.25
Detroit	2.15	1.90	1.70	1.05	1.15	.85	1.45	1.45	1.65‡	1.65‡	6.50
Kansas City	2.56	2.31	2.16	1.85	2.30	1.00	1.91	1.91	....	....	7.90*n*
Los Angeles	2.82*b*	2.62*b*	....	1.68	1.68	1.68	1.68*f*	1.68*f*	....	....	7.00
Minneapolis	3.00	2.75	....	1.00*h*	1.00*h*	.25*h*	1.00*h*	1.00*h*	....	....	7.40*j*
Montreal	....	....	1.58	...	...	1.25‡	.90‡	1.00‡	....	....	7.60*l*
New Orleans	2.41	2.16	....	1.50	1.50	1.25	....	....	....	....	7.25
New York	2.55‡	2.35‡	....	1.20/1.25*de*	1.20/1.25*de*	.75*de*	1.65*de*	1.75*de*	....	....	7.25
Philadelphia	2.32	2.07	1.87	1.55‡	1.65‡	1.25‡	....	....	1.00	1.00	7.95*k*
Pittsburgh	2.44	2.19	1.99	1.80‡	1.80‡	2.10‡	2.25‡	2.25‡	1.50	1.50	8.75
St. Louis	2.55	2.30	....	1.50‡	1.50‡	1.25/1.50‡	.85*h*	.85*h*	.75*g*	.75*g*	7.50
San Francisco	2.72	2.52	2.20	1.35	1.35	1.35	1.50	1.50	....	....	7.50
Seattle	3.10*o*	2.85*o*	....	1.17*o*	1.17*o*	1.17*o*	1.33*o*	1.33*o*	....	....	7.30*o*

‡Delivered. *a* 10c. allowed for each returnable bag. *b* 10c. per bbl. off for cash. *d* Per cu. yd. *e* Barge lots alongside docks *f*Crushed granite Square. *j* 5% discount for cash. *k* Discount 35c. 500 to 2000; 70c. 2000 to 5000; 95c. over 5000. *l* Up to 200 cu. yd. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 10c per ton off, cash 15 days. *g*F.o.b. Granite City, Ill. *h* F.o.b. plant. *i*Within three miles of Public

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice, in Montreal 5% if payment before 15th.

CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind.	$1.70	$1.65	Ironton, Ohio	$1.60	$1.55	Richard City, Tenn.	1.80	1.75
Dallas, Tex. (Inc. 5c. tax)	1.80	1.75	Limedale, Ind.	1.70	1.65	Steelton, Mimn	1.80	1.75
Hannibal, Mo.	1.70	1.65	Norfolk, Va.	1.65	1.60	Universal, Pa.	1.65	1.60
Hudson, N. Y.	1.75	1.70	Northampton, Pa.	1.55	1.50	Waco, Tex. (Plus 5c. Tax in Texas)	1.75	1.70
Independence, Kans.	1.70	1.65	North Birmingham, Ala.	1.70	1.65			

LOWER PENINSULA, MICHIGAN. Uniform carload lot cement price established March, 1937.

PAVING BRICK, BLOCKS, ASPHALT, ROAD OILS—F.O.B. CITY

	PAVING BRICKS AND BLOCKS			PAVING ASPHALT (Per ton, less than 80 penetration)		ASPHALT BINDERS—FLUXES (Per gal., 80–300 penetration)		CUTBACK ASPHALT (Per ton)		ROAD OILS (Per gal.)	ASPHALT EMULSION (Quick-breaking) (Per gal.)	
	Granite per M, lots of 50,000, 4x4x8 in.	Brick per M, 3x4x8½ in., carload lots	Wood per sq. yd., 3½ in. 16-lb. treat	Tank car	Drums	Tank car	Drums	Tank car	Drums	Tank car	Tank car	Drums
Atlanta	$75.00	$39.35	$2.25	$16.60*e*	$21.80*e*	$0.0675*e*	$0.0968*e*	$.0734*he*	$.1053*he*	$0.0584*e*	$0.0834	$0.0834
Baltimore	140.00	44.00‡	2.50	13.00	18.00	.06	.085	.07*h*	.10	.....	.....	.....
Birmingham	.....	25.00	.....	18.20	23.20	.0747	.1047	.0834*h*	.1134*h*	.....	...	.....
Boston	75.00	45.00	3.00	13.00	18.00	.05	.08	.06*h*	.09*h*	.....	.09‡	.12‡
Chicago	140.00	50.00	2.50	14.00	18.00	13.00*g*	17.00*g*	.06*h*	.11*h*	.0325	.08	.12
Cincinnati	112.00	37.50	.....	13.31	17.31	.09	.....	16.00	.....	.051	.078	.....
Cleveland	110.00	37.25	2.80	15.25	20.50	.07	.08	.07*h*	.085*h*	.05	.08	.09
Dallas	.....	30.50	.....	12.00	17.00	.04	.07	13.00	18.00	.035	.05/.07	.07/.09
Denver	.....	27.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	35.00	.....	14.10*f*	20.00*f*	14.00*g*	18.40*g*	14.00	19.70	.0535	.066	.0995
Kansas City	.....	44.00	.....	18.50	23.50	.077	.1075	.077*h*	.107*h*	.057	.11	.15
Los Angeles	.....	50.00	.....	6.50*b*	15.00	6.50*b*	15.00*g*	5.50*b*	.....	.0192	.0525	.1125
Minneapolis	.....	.....	1.90*d*	19.20	25.20	.10	.12	19.30	28.80	.056	.....	.....
Montreal	82.50	.....	3.62	14.60	21.25	.105	.1375	.101*h*	.121*h*	.0935	.13	.16
New Orleans	.....	.....	.....	14.00*a*	19.00*a*	.055	.085	.06*h*	.09*h*	...	.078	.....
New York	.....	68.00	2.90	13.50	18.50	.055	.08	.06*h*	.09*h*	.....	.0725	.1025
Philadelphia	120.00	42.50	2.84	14.00	19.00	.055	.08	.06*h*	.09*h*	.05	.06	.09
Pittsburgh	115.00	40.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
St. Louis	110.00/121.00	37.00	. ....	15.00	20.00	.055	.085	7.00	17.50	.035	.075	.115
San Francisco	.....	70.00	.....	6.50	15.00	6.50*g*	15.00*g*	7.00	17.50	.025	.0475	.117
Seattle	.....	60.00*c*	.....	13.90	22.90	.....	24.50*g*	9.50/10.50	23.00/24.00	7.75	.0575	.1308

‡Delivered. *a*F.o.b. Baton Rouge. *b*Delivered to purchaser's warehouse. *c*3½x4x8½ in. *d*2½ in. 6 to 8-lb. treatment. *e*Local reduction due to 20% reduction intra-state class freight rates, only Georgia affected. *f*Mexican. *g* Per ton. *h* Per gallon.

(Continued from page 44)

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¼-in. billet *b*	RIVETS ½-in. structural	WIRE NAILS Base	SHEET PILING Base	STEEL RAILS Per Gross Ton: Standard	Light	Re-rolled	TRACK SUPPLIES: Angle bars	Std. spikes *c*	Tie plates	Track bolt
Birmingham	$2.10	$2.05	$3.40	$2.45	....	$40.00	$40.00	$39.00	$2.70	$3.00	$2.15	$4.15
Chicago	2.10	2.05	3.40	2.45	$2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.15
Pittsburgh	2.10	2.05	3.40	2.45*d*	2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.15
Buffalo	2.10	2.05	....	....	2.40	....	....	....	....	....	2.15	....
Cleveland	2.10	2.05	3.40	2.45	....	....	....	....	....	....	....	....
Youngstown	....	2.05	....	....	....	....	....	....	....	3.00	....	....
Detroit	....	2.15‡	....	....	....	....	....	....	....	....	....	....
Gulf ports	2.45*a*	2.40*a*	....	....	2.85*a*	....	....	....	....	....	....	....
Pacific ports	2.70*a*	2.50*a*	....	....	2.90*a*	....	....	....	....	3.00	2.25	....

‡ Delivered. *a* F.o.b. cars dock. *b* For rail steel deduct 15c. from billet prices. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates alone, Steelton, Pa., on spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per o.l.

IRON AND STEEL PRODUCTS—F.O.B. WAREHOUSE, PER 100 LB., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb., base price	REINFORCING BARS Per 100 lb., ¾ in., base price: 15 tons or over *b* New billet	Rail steel	Add $/cwt. for Switch	Del.	EXPANDED METAL LATH —Per 100 sq.yd., carload lots— Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING —Per 100 s.f., carload lots— 4x10 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6 & 6 wires Per sq. yd.	SHEET PILING Per 100 lb. base price
Atlanta	$2.74	$2.29	$2.14	.02½	.10	$21.00	$23.00	$1.66	$1.25	$0.1566	$3.04
Baltimore	3.55	2.70	2.55	....	.10	21.00	23.00	1.54	1.17	.1458	2.70
Birmingham	2.10*a*	2.05	1.90	.02½	.10	19.50	21.50	1.64	1.23	.1548	..
Boston	3.85	2.58	2.43	$20 C.L.	.10	21.00‡	23.00‡	1.60	1.21	.1512	2.99
Chicago	2.10*a*	2.05	1.90	.03	.05	18.50	20.50	1.51	1.15	.1422	2.40
Cincinnati	3.88	2.31*c*	2.16*c*	....	.05	20.50	22.50	1.50	1.14	1413	....
Cleveland	3.43*g*	2.05	1.90	.02½	.10	20.50	22.50	1.50	1.14	.1422	....
Dallas	4.15	2.80	2.65	....	....	25.00	27.00	1.77	1.32	.1674	....
Denver	4.21	3.89	3.74	....	....	23.50	25.50	1.81	1.34	.1710	....
Detroit	3.80‡	2.55	2.40	....	.10	22.50	24.50	1.52	1.16	.1440	2.87½
Kansas City	4.10	2.51*c*	2.36*c*	.0	.05	18.50	20.50	1.62	1.22	.1539	2.86
Los Angeles	3.50*f*	2.65	2.50	.02½	.05	23.50	27.50	1.77	1.32	.1674	3.50
Minneapolis	3.80‡	2.38*c*	2.23*c*	.0	.10	21.50	24.50	1.64	1.23	.1548	2.73*d*
Montreal	3.25	2.65	2.55	....	....	26.68	29.90	2.99	2.08	.314	3.95
New Orleans	3.90	2.69	2.54	.05	.10	21.00	23.00	1.67	1.26	.1584	2.87½
New York	3.75	2.29	2.14	....	.10	20.50	22.50	1.56	1.19	.1476	2.76
Philadelphia	3.40	2.37	2.22	...	...	20.50	22.50	1.55	1.18	1467	2.72
Pittsburgh	2.10*a*	2.05	1.90	.02½	.10	21.50	24.50	1.43	1.10	.1350	2.40
St. Louis	3.82	2.29	2.14	.0	.05	23.50	25.50	1.53	1.16	.1449	2.70
San Francisco	3.95	2.50	2.35	.02½	.10	23.50	25.50	1.77	1.32	.1674	3.00
Seattle	2.70*e*	2.65*e*	....	....	....	25.50	27.50	1.77	1.32	.1674	2.90*e*

‡ Delivered. *a* Mill prices. *b* 5–15 tons, add 15c. 1–5 tons, add 25c. Less than 1 ton, add 50c. *c* 20 tons or over Base. *e* Mill price plus freight. *e* F.o.b dock. *f* Includes delivery in free delivery zone. *g* Less than 1 ton, add 30c; 1 to 5 tons, add 10c.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in.*a*	VITRIFIED SEWER PIPE Per foot, delivered 8 in., s.s.	12 in., s.s.	ASTM 24 in. d.s.	C13–35 36 in., d.s.	CLAY DRAIN TILE Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	CONCRETE SEWER PIPE Per ft., delivered: ASTM C 14–35 12 in.	24 in.	WROUGHT STEEL PIPE Full standard weight *h*: 1 to 3 in., Butt Weld Black %	Galv. %	3½ to 6 in., Lap Weld Black %	Galv. %
Atlanta	$46.40	$0.26*bc*	$0.468*bc*	$1.69	$4.50*c*	$85.00	$128.00	$0.45	$1.625	62.2	54.2	59.7	51.2
Baltimore	49.80	.30	.55	2.40	6.25	110.00	170.00	.50	1.75	65.5	57.5	63.0	54.5
Birmingham	42.00	.25	.45	1.625	4.66	85.00	220.00	.40	1.60	62.2	54.2	59.7	51.2
Boston	52.00	.28	.54	2.475	6.67	136.00‡	196.50‡	.50	2.50	64.1	56.1	61.6	53.1
Chicago	50.80	.28	.54	2.25	6.25	100.00‡	150.00‡	.38	1.48	67.0	59.0	63.5	55.0
Cincinnati	49.70	.203	.3915	1.665	5.0225	75.00	120.00	.60	1.90	65.9	57.9	63.4	54.9
Cleveland	51.24	.175	.3375	1.35	4.2025	69.00	108.00	.34	1.45	67.8	59.8	65.3	56.8
Dallas	55.20	.27	.486	1.944	4.70	80.00	100.00	.46	1.57	59.9	51.9	57.3	48.3
Denver	57.60	.39†	.50†	2.10†	....	190.00	220.00	....	....	58.4	50.4	55.7	47.2
Detroit	51.24	.147	.2835	1.215	4.70	66.45	111.40	.25	1.125	66.3	58.3	63.8	55.8
Kansas City	52.12	.30	.54	2.16	5.00	120.00	240.00	.45	1.60	62.9	54.9	60.0	51.5
Los Angeles	52.00	.282†	.508†	2.034†	5.085†	115.50	192.50	1.00	2.00	56.8	47.8	54.3	44.8
Minneapolis	54.20	.24†	.432†	1.728†	4.60†	.....	.....	.70	1.80	64.2	56.2	60.7	52.2
Montreal	60.00	.59	.90	3.15	5.10*e*	135.00‡	260.00‡	.48	1.92	....	....	....	....
New Orleans	48.38	.26	.48	1.69	....	150.00	220.00	.37	2.10	62.4	54.4	58.8	50.3
New York	49.20	.29	.57	2.25	6.15	.....	.....	.64	1.70	64.9	56.8	62.4	53.9
Philadelphia	47.90	.21	.405	1.75	5.05	100.00	160.00	.54	1.80	65.3	57.3	62.8	54.3
Pittsburgh	52.50	.182†	.351†	1.44†	4.20	97.80	154.20	.85*g*	2.00*g*	68.5*i*	60.5*i*	66.0*i*	57.5*i*
St. Louis	49.48	.28	.504	2.016	3.96	85.00	170.00	.80	2.00	65.1	57.1	62.0	53.5
San Francisco	52.00	.3275*d*	.5895*d*	2.358	5.895	107.25	178.75	.45	2.50	....	....	....	....
Seattle	52.35	.35	.63	2.52	6.30	72.00	175.00*f*	.60	1.60*f*	....	....	....	....

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, C/L lots, 200 tons and over Burlington, N. J. (base) $46.00. Gas pipe and class A, $3 per ton additional, 4 in., $3 per ton additional, 30 in. and larger usually $2 per ton less. *b* Double strength. *c* List to dealer. *d* List. *e* 30-inch. *f* Less 5% for cash. *g* Culvert pipe. *h* Discounts from standard list consumers carload prices, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ¼ in., 8½c.; ⅜ in., 11½c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92.

i Applies also at Lorain, Ohio, mills. Chicago delivered base is 2½ points less Freight is figured from Pittsburgh, Lorain, O., Chicago Dist. Billing is from point producing lowest price at destination. WROUGHT IRON PIPE: Base price and list prices per ft. same as wrought steel pipe. Discount for Pittsburgh base: Butt-weld — 1 in. and 1¼ in. black 34, galv. 19; 1½ in. black 38, galv. 21½; 2 in. black 37½, galv. 21. Lapweld — 2½ in. to 3½ in. black 31½, gavl. 17½; 4½ in. to 8 in. black, 32½ galv. 20.

LUMBER, TIMBER, PLYWOOD—PER M FT. B.M., CARLOAD LOTS F.O.B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face) *All Fir planks No. 2 common; Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)*									LONG LEAF Y. P. Merchantable grade up to 20 ft.		PLYWOOD Rail freight increment (See note for base price)	
	1x6, S4S	1x8, S4S	2x4, S4S	2x6, S4S	2x8, S4S	2x10, S4S	3x12, R/S	6x12, R/S	12x12, R/S	2x12, R/S	12x12, R/S	5/8"	3/4"
Atlanta	$18.50	$18.50	$18.50	$19.00	$19.00	$19.50	$26.00	.....	.....	$38.50	$50.00	$17.75	$21.60
Baltimore	24.00	25.00	24.00	25.00	26.00	27.00	39.00	.....	.....	66.00	70.00	17.35*g*	21.15*g*
	31.00	*31.00*	*31.00*	*30.00*	*31.00*	*31.00*	*39.00*	*$39.00*	*$39.00*	.....	.....	.....	.....
Birmingham	19.00	19.00	19.00	19.00	19.00	20.00	30.00	30.00	30.00	.....	.....	16.25	19.85
	22.00	22.00	26.00	26.00	26.00	36.00	54.00	.....*e*	.....	48.00	53.00	.....	.....
Boston	28.00[3]	28.00[3]	32.00[3]	32.00	48.00[1]	60.00[1]	72.00[1]	.....	.....	72.00	72.00	17.35*g*	21.15*g*
	28.00	*28.00*	*30.00*	*30.00*	*32.00*	*32.00*	*35.00*	*40.00*	*40.00*	.....	.....	.....	.....
Chicago	27.00	28.00	30.00	30.00	30.00	30.00	45.00	.....	.....	75.00	75.00	13.15	16.05
	32.00	*33.00*	*36.00*	*36.00*	*36.00*	*36.00*	*40.00*	*39.00*	*39.00*				
Cincinnati	23.75	23.75	25.00	23.25	24.25	26.50	37.50	.....	.....	46.00	49.00	16.25	19.85
	.....	.....	.....	.....	.....	.....	*39.50*	*39.50*	*39.50*	.....	.....	.....	.....
Cleveland *f*	30.60	31.00	36.00	31.00	32.00	40.00	48.00	.....	.....	52.00	62.00[3]	16.65	20.25
Dallas *e*	28.50	31.50	30.00	26.00	28.50	31.50	55.00	54.00	54.00	64.50	71.00	13.90	16.95
Denver ‡	41.00[4]	39.00[4]	43.00[4]	42.00[4]	42.00[4]	47.00[4]	45.00[4]	56.00[4]	64.50[4]	.....	.....	9.90	12.05
Detroit	24.00	24.00	25.00	25.00	26.00	26.00	35.00	.....	.....	30.50	40.00	16.25	19.85
	.....	.....	.....	.....	.....	*36.00*	*38.00*	*40.00*	*40.00*	.....	.....	.....	.....
Kansas City	27.00	28.50	28.00	26.00	28.00	30.00	35.00	.....	.....	55.00	58.00	12.25	14.95
	28.00	*28.00*	*28.00*	*28.00*	*28.00*	*29.00*	*34.00*	*35.00*	*35.00*	.....	.....	.....	.....
Los Angeles *a*	*35.00*	*35.00*	*35.00*	*35.00*	*36.00*	*36.00*	*42.00*	*46.00*	*42.00*	.....	.....	9.35*gh*	11.35*gh*
Minneapolis ‡*b*	43.00[3]	43.00[3]	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.05	14.70
‡	*34.00*	*34.00*	*35.00*	*35.00*	*35.00*	*35.00*	*55.00*	*55.00*	*55.00*	.....	.....	.....	.....
Montreal [7]	*45.00*	*45.00*	*49.00*	*47.00*	48.00	58.00	84.00	.....	.....	135.00	145.00	.....	.....
	40.00	*40.00*	*40.00*	*40.00*	*40.00*	*41.50*	*42.00*	*41.00*	*40.00*	.....	.....	.....	.....
New Orleans	22.00	22.00	20.00	19.00	20.00	22.00	42.00	.....	.....	58.00	65.00	13.90	16.95
	26.00	*26.00*	*28.00*	*29.00*	*32.00*	*30.00*	*32.00*	.....	.....	.....	.....	.....	.....
New York ‡	36.00	37.00	35.00	36.00	36.00	37.00	42.00	.....	.....	77.50	80.00	17.35*g*	21.15*g*
‡	.....	.....	*40.00*	*40.00*	*40.00*	*40.00*	*40.00*	*42.50*	*42.50*	.....	.....	.....	.....
Philadelphia	23.50	24.00	25.00	25.00	26.00	26.50	28.50	.....	.....	54.00	56.00	17.35*g*	21.15*g*
	34.00	*35.00*	*38.00*	*37.25*	*36.50*	*36.50*	*41.75*	*31.50*	*31.50*	.....	.....	.....	.....
Pittsburgh	38.10	39.90	47.05	42.00	45.65	46.90	59.70	.....	.....	.....	.....	17.00	20.70
	51.90	*49.60*	*49.60*	*49.00*	*48.90*	*49.25*	*66.55*	*66.55*	*66.55*	.....	.....	.....	.....
St. Louis ‡*c*	31.50	32.50	31.00	30.00	31.00	32.50	49.00	*51.00*	*51.00*	74.00	73.00	13.90	16.95
San Francisco *d*	*19.00*	*19.00*	*19.00*	*19.00*	*19.00*	*19.00*	*23.00*	*23.00*	*23.00*	.....	.....	7.30*g*	8.90*g*
Seattle	*20.00*	*20.00*	*20.00*	*20.00*	*20.00*	*20.00*	*26.00*	*26.00*	*26.00*	.....	.....	0.00	0.00

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [1] Long leaf. [2] Roofers' N.C. Pine. Spruce. [4] Native. [5] Western Pine, No. 3 Common. [7] Pine. [8] Norway Pine. ‡ Delivered. *a* Yard prices. *b* Contractors discount in Minneapolis and St. Paul discontinued May 21, 1938. *c* 5M ft. or less. *d* At ship's tackle. *e* 10% discount taken off.

Note: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, car load lots, delivered per 1000 sq. ft. surface. Base price — Seattle: ⅜", $66.94; ½", $76.39. For other centers add rail freight increment from table for proper size. Add: *f* or form oil treatment, $2.50 per M. sq. ft.; for mineral paint sealed edges, $1.00 per M; for resin dipped treatment, $10.00 per M. *g* Lower rate by water shipment. *h* 50,000 lb. minimum

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS — Discounts from latest jobbers list, Sept. 15, 1928 Single or Double Thickness A quality	B quality	EXPLOSIVES — Per lb. 40% Ammonia Gelatin in 50-lb. cases delivered in 200 lb. lots*
Atlanta	88%	88%	$0.16
Baltimore	88%	87%	.16
Birmingham	89%	90%	.115
Boston	87%	89%	.16
Chicago	79%*c*	79%*c*	.16
Cincinnati	89–10%	9i–10%	.16
Cleveland	85–10%	85–10%	.20
Dallas	80%	80%	.175
Denver	85%	86%	.16*d*
Detroit	87–10%	89–10%	.16
Kansas City	78–10%	79–10%	.165
Los Angeles	90%*a*	90@40%	.1675
Minneapolis	87–10%	88–10%	.165
Montreal	70–10%*b*		.18†
New Orleans	86%	88%	.17
New York	89%	90%	.23*e*
Philadelphia	89–10%	90–10%	.16
Pittsburgh	86%	87%	.1525
St. Louis	86–10%	87–10%	.165
San Francisco	78%	83%	.165
Seattle	86%	90%	.1675

Price of 60% Ammonia Gelatin is $0.015 per lb higher than 40%

a Disc. from list Aug 1, 1925. *b* Also less 6% tax exemption. *c* Discounts from jobbers list, Nov. 16, 1938.

* Urban prices influenced by service charges or local storage and delivery regulations, do not consistently reflect quantity prices in less congested areas. *d* F.o.b. Louviers, Colo. *e* In boroughs of Kings, Queens and Richmond, and in Manhattan south of Canal Street, add delivery charge of $6.00 per trip. † F.o.b.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla.	$0.115	$0.14	$0.16
W. of Miss., to Rocky Mtn. States, and Fla.	.12 –.13	.145 –.16	.165 –.18
Rocky Mtn. States	.12 –.1425	.14 –.155**	.16 –.175**
Pacific N. W. States	.1175–.13	.1475–.16	.1675–.18
Pacific S. W. States	.1150–.1275	.145 –.1525	.165 –.1725

** F.o.b. Louviers, Colo., or Butte, Mont.

PILES, TIES—F.O.B.

PILES

Prices per linear foot, pine, with bark on, f.o.b. New York; delivered from barge 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Short Leaf — Barge	Short Leaf — Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.18	$0.195
12 in.—2 ft. from butt.	6 in.	50 to 59 ft.	.225	24
12 in.—2 ft. from butt.	6 in.	60 to 69 ft.	.23	.255
14 in.—2 ft. from butt.	6 in.	50 to 69 ft.	.24	.265
14 in.—2 ft. from butt.	6 in.	70 to 79 ft.	.28	.275
14 in.—2 ft. from butt.	5 in.	80 to 85 ft.	.40	.415
14 in.—2 ft. from butt.	5 in.	85 to 89 ft.	.42	.482

RAILWAY TIES

Prices f.o.b., per tie, for carload lots:

		6" x 8" x 8' Untr.	6" x 8" x 8' Tr.	7" x 9" x 8' 6" Untr.	7" x 9" x 8' 6" Tr.
Boston	Oak	$1.10	....	$1.60	....
	Pine	1.25	$1.90*a*	1.85	$2.75*a*
New York	S.L. Sap Pine	1.05/1.15	1.90*g*	...	2.35*g*
	Mixed Oak	1.50	1.35	1.85	....
Birmingham	White Oak	.85	1.50*a*	1.35	1.70*a*
	Southern Pine	.55*b*	1.10*ab*	.70	1.30*a*
Chicago	Oak	....	1.65*a*	....	2.25*a*
	Southern Pine	....	1.53*a*	....	2.13*a*
Los Angeles	Douglas Fir	.64	1.38*a*	.90	1.80*a*
Philadelphia	Red Oak	1.10	....	...	2.40*a*
St. Louis	White Oak	.90	....	1.20	....
	Red Oak	.90	1.40*a*	1.20	1.80*a*
	Sap Pine or Cypress	.80	....	1.10	...
San Francisco	Douglas Fir	.80*bef*	....	....	1.85*eaf*
Montreal	Birch or Maple	.65	1.05*a*	.75	1.35*a*

Tr.—Treated; Untr.—Untreated. *a* Creosoted. *b* 6" x 8" x 8' 6" *c* Empty cell. *d* Zinc. *e* Green. *f* At ships tackle. *g* Dense pine

CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder, in drums, f.o.b. works, per 100-lb	$2.00–2.85
Chlorine cylinders, per lb. delivered	.055
Calcium chloride, 77–80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, f.o.b. works, freight equalized with points of competition, per ton	22.00–35.00
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb.	1.40
Soda ash, 58%, in paper bags, per 100 lb. dense	1.10
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	23.00
Sulphate of copper, in bbl., per 100-lb.	4.50

(Continued on adv. page 39)

(Continued from editorial page 46)

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE — PARTITION — SCORED Per M. lots of 2,000 pieces or over. 3x12x12 in.	4x12x12 in.	8x12x12 in.	STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M. lots of 2,000 pieces or over. 8x12x12 in.	10x12x12 in.	12x12x12 in.	BRICK Per M. in quantity. Common backing	Straight hard	LIME Per ton. Hydrated finishing	In paper Common hydrated	Carload lot Pulverized or lump
Atlanta	$100.00	$120.00	$200.00	$230.00	$240.00	$250.00	$11.50	$16.00	$24.00	$15.50	$15.50
Baltimore	74.00	80.00	165.00	195.00	250.00	300.00	13.00*k*	16.00*k*	14.00	15.00	22.00
Birmingham	78.75	84.00	157.50	189.00	201.25	242.00	15.00	19.00	3.00*o*	1.75*o*	2.25*lo*
Boston	90.75*ab*	96.80*ab*	181.50*ab*	205.70*ab*	266.70*ab*	304.80*a*	17.00*i*	20.00*i*	19.00	13.00	3.10*lp*
Chicago	68.10	72.60	136.90	185.70	234.90	268.10	11.00	12.00	15.00	14.40	12.20
Cincinnati	56.45	60.40	115.25	138.70	166.50	206.40	16.00	16.00	15.90	13.00	.....
Cleveland	52.50	56.00	105.00	126.00	170.00	194.50	15.50	15.50	15.20*j*	12.80*j*	2.65*jm*
Dallas	62.50	67.00	135.00	162.00	177.00	263.00	11.50*i*	13.50*i*	19.00	15.00	.95*n*
Denver	78.50	88.00	141.50	166.50	196.00	225.50	12.00	15.50	28.00*j*	17.00*j*	35.00*j*
Detroit	68.90	73.50	137.80	175.50	232.00	265.00*e*	16.00	17.00	13.50	11.25	12.75
Kansas City	64.50	66.50	86.00*e*	125.50	159.75	186.25	14.00	24.00	19.10	12.80	10.70
Los Angeles	73.50†*r*	89.50†*r*	128.00*e*†*r*	210.00†*r*	368.00†*r*	460.00†*r*	12.00	14.00	18.70	.....	19.70
Minneapolis	80.35	85.70	146.00	192.85	176.20*d*	245.20*d*	13.10	15.10*g*	21.00	16.00	19.00
Montreal	64.00*a*	77.00*a*	141.00*a*	77.00*a*	128.00*a*	.....	21.00	31.00	24.60	16.00	1.75*lo*
New Orleans	72.00	72.00	135.00	162.00	210.00	260.00	14.00	.....	18.30	12.08	14.10
New York	87.00	93.00	128.00	193.30*h*	238.80*h*	295.60*h*	13.50	.....	20.00	15.00	18.00
Philadelphia	77.40	82.50	154.70	185.70	229.90	284.60	11.00*s*	18.00*s*	15.50*q*	10.05	10.55
Pittsburgh	58.40	62.40	116.85	124.00	153.00	193.75	17.00	25.00	17.70	15.20	2.57*m*
St. Louis	62.00	65.00	120.00	180.00	234.00	280.00	16.00	17.00	22.00	16.00	2.30*lm*
San Francisco	84.00	94.50	225.00	.....	.....	.....	14.00	17.00	.55*o*	.40*o*	2.05*m*
Seattle	100.00	110.00	220.00	.....	.....	.....	17.50*f*	17.50*f*	20.00*s*	20.00*s*	20.00*s*

† F.o.b. *a* Smooth. *b* Carload lots delivered to job. *c* 6 x 12 x 12 in. *d* Not load bearing. *e* 48 lb. tile. *f* Less $1.00, ½ cash 15 days, balance 30 days. *g* Selected common. *h* F.o.b. Perth Amboy, N. J. *i* 50c per M. off for cash. *j* LCL. *k* $1.00 discount if paid in 10 days. *l* Lump. *m* Per bbl., 180 lb. *n* Per sack 100 lb. *o* Per bbl., 200 lb. *p* 280 lb. bag. *q* 15-ton cars. *r* 5% discount 10 days. *s* 2% off cash. *t* 5½ x 8 x 12.

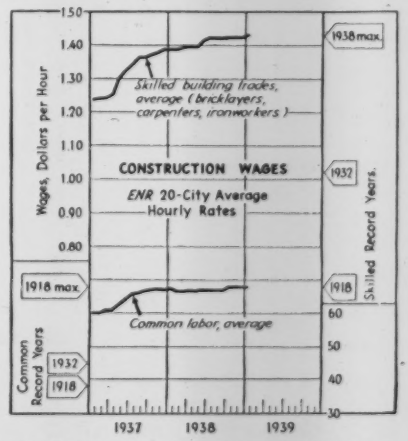
PAINT, ROOFING—F.O.B. CARLOAD LOTS

	RED LEAD Per 100 lb. in 600-lb. (Approx.) bbl. Dry *a*	WHITE LEAD Per 100 lb. in oil	READY-MIXED PAINT Per gal., drums Graphite *b*	Aluminum *c*	Ferric Oxide *d*	ROOFING SUPPLIES Carload lots f. o. b. factory Rolls, slate surfaced, 85–90 lb., per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 350 lb. bbl per ton
Atlanta	$8.50	$12.125	$1.30	$2.25	$1.20	$1.71	$1.65	$1.65	$.36	$26.00
Baltimore	8.25	11.75	1.45	2.25	1.70	2.16	2.75	2.75	.40	27.50
Birmingham	8.50	12.125	2.35	2.35	1.85	2.07	2.03	2.03	.45	30.37
Boston	8.25	11.75	1.80‡	2.20‡	1.80‡	1.75‡	1.90*h*‡	1.90*h*‡	.40‡	20.00‡
Chicago	8.25	11.75	1.88	2.53	1.56	1.53*hf*	1.59*hf*	1.59*hf*	.26*f*	23.00*f*
Cincinnati	8.25	11.75	1.45	2.50	1.40	2.40	2.39*h*	2.39*h*	.36	21.00
Cleveland	8.25	11.75	1.90	2.60	1.40	1.45	1.50*h*	1.50*h*	.36	21.00
Dallas	8.25	12.50	1.80	1.95	....	2.75*h*	2.50*h*	2.50*h*	.60	.....
Denver	8.75	12.25	....	....	....	2.45	4.00	3.00	.35	28.00
Detroit	8.25	11.75	2.00	3.00	1.75	2.40	3.25	3.25	.35	29.00
Kansas City	8.25	11.875	2.15*g*	2.40*g*	1.67*g*	1.93	2.09	2.09	.25	25.00
Los Angeles	8.50	12.25	1.60	2.25	2.30	2.10	1.50	....	.45	.....
Minneapolis	8.25	11.875	....	....	....	1.40*i*	1.45*hi*	1.45*hi*	.29	21.00
Montreal	9.75	9.00	2.25	2.80	2.35	3.05	1.85	2.15	.95	10.80*k*
New York	8.25	11.75	1.80	2.45	1.48	1.45	1.50*h*	1.50*h*	.23	24.00
Philadelphia	8.25	11.75	....	....	....	1.92*e*	1.99*he*	1.99*he*	.41*e*	21.00
Pittsburgh	8.25	11.75	1.05	1.95	.80	1.95	1.94*h*	1.94*h*	.34	26.00
St. Louis	8.25	11.75	1.70/1.90	2.50/2.75	1.50/1.90	1.45	1.50	1.50	.23	21.00
San Francisco	8.50	12.00	1.80	2.75	1.10/2.00	1.66	1.90	1.90	.325	20.50
Seattle	8.50	12.25	1.80	3.00	2.20	2.02	1.43/2.10	2.60	.54	24.10*j*

‡ Delivered. Note: Red lead in oil 50c. higher than white lead in oil. *a* Red lead prices change frequently due to pig lead price changes. *b* U. S. War Dept. Spec. 3-49A. *c* ASTM Spec. D266–31. *d* 80% maximum ferric oxide. *e* Subject to 25% discount. *f* Distributors' price to contractors. *g* 5 gal. can. *h* Per roll, 65 lb. *i* Minneapolis and vicinity. *j* Asphalt pitch. *k* 550 lb. barrel.

SKILLED AND COMMON WAGE RATES—PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Common Labor Building	Common Labor Heavy Const.
Atlanta	$1.25	$1.00	$1.25	$1.00/1.25	$1.25	$0.40/.50	$0.40/.50
Baltimore	1.50	1.25	1.50	1.50	1.25	.50	.50
Birmingham	1.50	1.125	1.25	1.125	1.00	.30/.40*a*	.30/.40*a*
Boston	1.50	1.375	1.80	1.375	1.625	.60/.85	.60/.85
Chicago	1.70	1.625	1.70	1.625	1.70	1.025	1.025
Cincinnati	1.00/1.625	.70/1.35	1.40	1.00/1.40	1.00/1.625	.60/.75	.60/.75
Cleveland	1.625	1.375	1.50	1.50	1.50	.90	.90
Dallas	1.50	1.25	1.25	1.00	1.50	.40	.40
Denver	1.50*b*	1.50*b*	1.43*b*	....	1.43*b*	.718*b*	.718*b*
Detroit	1.50	1.25	1.50	1.50	1.55	.60/.80	.60/.80
Kansas City	1.625	1.375	1.50	1.50	1.575	.85	.45/.50
Los Angeles	1.25	1.10	1.375	1.375	1.50	.625	.625
Minneapolis	1.375	1.25*d*	1.50	1.40	1.50*e*	.85	.85
New Orleans	1.00	1.00	1.25	1.00	1.00	.40	.40
New York	1.886*b*	1.75*b*	1.925	2.00*b*	2.00*c*	1.031	.875/.95
Philadelphia	1.65	1.25	1.50	1.50	1.565	.60	.60
Pittsburgh	1.75	1.50	1.50	1.25	1.75	.80	.70
St. Louis	1.50	1.25	1.75	1.57/2.00	1.58	.45/.875	.45/.875
San Francisco	1.75*c*	1.25*f*	1.50	1.50	1.60*c*	.81	.65
Seattle	1.60*c*	1.25*c*	1.50*c*	1.50*c*	1.60*c*	.90*c*	1.00*c*
Montreal	.70	.60	.60	.55	.67	.35	.40



a PWA *b* 7 hr. day. *c* 6 hr. day. *d* 35 hr. wk. *e* 30 hr. wk. *f* Working under "stop-gap" agreement.

ENR Skilled Average: (Bricklayers, Carpenters, Iron workers) **$1.432**
ENR Common Average: $0.682

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

DELAWARE AQUEDUCT, NEW YORK

OWNER: Board of Water Supply of the City of New York; George J. Gillespie, president.

PROJECT: Contract No. 319. Construction of a portion of the Rondout-West Branch tunnel of the Delaware aqueduct, in the towns of Fishkill and East Fishkill, Dutchess County, and Kent and Putnam Valley, Putnam County, New York. This contract consists of 55,900 ft. of 13½-ft. finished diameter tunnel. To be driven from shafts 7 and 8, completed under previous contract. Time for completion of this contract is 66 months. In placing concrete in the tunnel, special care is to be taken to force the concrete into all the unevennesses of the rock. Concrete for the lining in the upper portions of the tunnel shall be placed by pneumatic or mechanical methods through pipes which discharge as nearly as practicable in the highest part of the excavation. Minimum labor rates are as follows: skilled, $1.20 per hr.; semi-skilled, 75c. per hr.; common, 65c. per hr.

BIDS: Nine bids were received Dec. 6, 1938, ranging from the contract low of $11,431,975 to $19,019,075.

LOW BIDDERS:

1. Dravo Corp., Pittsburgh (contract) $11,431,975
2. Samuel R. Rosoff, Ltd., New York 12,673,600
3. Subway Construction Corp., Wilmington, Del. 13,939,450

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Test-borings	1,000 l. f.	$6.00	$5.00	$6.00
2. Excav. tunnel	550,000 c. y.	10.50	12.64	13.60
3. Enlarge. tunnel	7,500 c. y.	7.50	6.00	15.00
4. Protect. coatings, cement mortar	500 c. y.	24.00	16.00	25.00
5. Struct. steel support in tunnel	7,500,000 lb.	.07	.07	.08
6. Timbering in shafts and tunnel	1,200 M.b.m.	110.00	80.00	115.00
7. Dry packing	6,000 c. y.	7.50	5.00	8.50
8. Pumping from shafts and tunnel	2,000,000 Mil. ft. gal.	.15	.10	.20
9. Drainage channels for tunnel (ft. of tunnel)	56,000 l. f.	8.00	8.00	5.00
10. Forms, masonry lining of tunnel (ft. of tunnel)	56,000 l. f.	9.00	12.00	8.00
11. Conc. masonry in shafts and tunnel	250,000 c. y.	5.00	7.50	8.00
12. Excess conc. masonry	25,000 c. y.	5.00	5.00	5.00
13. Bit. curing sol. conc. masonry	70,000 s. y.	.09	.10	.08
14. Drilling holes	85,000 l. f.	.75	.50	.90
15. Steel pipes for grouting	55,000 l. f.	.80	.60	.75
16. Making connections, grouting	16,000 ea.	3.00	2.50	3.00
17. Sand for filters, grout and protective coatings of cement mortar	8,000 c. y.	3.50	5.00	4.50
18. Mixing and placing grout	25,000 c. y.	16.50	10.00	12.50
19. Earth excav	4,000 c. y.	3.00	1.00	2.00
20. Rock excav. in open cut	350 c. y.	10.00	5.00	15.00
21. Refilling and embanking	30,000 c. y.	1.00	.60	.75
22. Surface dressing and grassing	12,000 c. y.	1.50	1.00	2.00
23. Lumber in open cut	75 M.b.m.	110.00	80.00	150.00
24. Conc. masonry in open cut	50 c. y.	25.00	20.00	50.00
25. Vit. pipes	2,000 l. f.	1.00	1.00	1.50
26. Dry rubble masonry paving	100 c. y.	10.00	12.00	25.00
27. Rubble masonry, paving in mortar	100 c. y.	12.50	15.00	30.00
28. Cr. stone and gravel	100 c. y.	5.00	4.00	5.00
29. Cement	655,000 bbl.	2.30	2.00	2.50
30. Reinf.	2,500 lb.	.07	.10	.20
31. Misc. cast iron, wrought iron and steel	5,000 lb.	.15	.20	.20

CONTRACT 321: This contract is another part of the Delaware aqueduct for the Board of Water Supply, City of New York. It includes construction of the southerly portion of the Rondout-West Branch tunnel, the west branch by-pass tunnel and the northerly portion of the West Branch—Kensico tunnel—in the towns of Kent and Carmel, Putnam County, N. Y. Same general conditions as above prevail.

BIDS: Seven bids were received Dec. 20, 1938, ranging from $11,924,450 to $14,773,040. Time for completion is 70 months.

LOW BIDDERS:

1. Frazier-Davis Construction Co., St. Louis. . $11,924,450
2. Utah Construction Co., Ogden 11,964,190
3. Samuel R. Rosoff, Ltd., New York 12,226,050

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Land borings	1,000 l. f.	$5.00	$6.25	$6.50
2. Reservoir borings	1,000 l. f.	6.00	11.50	12.00
3. Excav. shafts, tunnels	380,000 c. y.	13.10	12.80	13.40
4. Enlargements, shafts, tunnels	7,000 c. y.	5.00	14.00	10.00
5. Protective coatings, mortar	400 c. y.	30.00	20.00	25.00
6. Struct.-steel support in shafts and tunnels	7,000,000 lb.	.05	.07	.04
7. Timbering, shafts and tunnels	1,400 M.b.m.	70.00	120.00	100.00
8. Dry packing	4,000 c. y.	6.00	7.50	6.00
9. Pumping from shafts and tunnels	350,000 Mil.f.ga.	.10	.15	.09
10. Drainage channels for shafts and tunnels	36,000 l.f.bore	27.00	8.00	30.00
11. Forms for masonry linings in shafts	25,00 l.f.shaft	35.00	35.00	20.00
12. Forms for masonry linings of tunnels	35,500 l.f.tunnels	15.00	9.00	20.00
13. Conc. masonry in shafts and tunnels	157,000 c.y.	8.00	8.25	7.50
14. Excess conc. masonry	16,000 c.y.	5.00	5.00	5.00
15. Bit. curing sol. for conc. masonry	50,000 s.y.	.03	.12	.10
16. Drilling in rock or masonry	50,000 l.f.	1.00	.75	.60
17. Steel pipes for grouting	37,000 l.f.	1.00	.75	.70
18. Making connections for grouting	11,000 ea.	3.00	4.00	2.50
19. Sand for filters, grout and protective coatings of cement mortar	6,500 c.y.	2.00	5.00	3.50
20. Grout	18,000 c.y.	8.00	13.75	10.00
21. Removal of soil	500 c.y.	1.00	1.50	2.00
22. Earth excav. in open cut	37,000 c.y.	.50	.75	1.50
23. Excav. under water	35,000 c.y.	.40	1.75	2.00
24. Rock excav. in open cut	60,000 c.y.	4.00	3.25	3.50
25. Refilling and embanking	70,000 c.y.	.50	.75	.60
26. Surf. dress., grassing	12,000 c.y.	3.00	2.00	1.00
27. Lumber in open cut	100 M.b.m.	70.00	120.00	100.00
28. Conc. masonry in open cut	36,000 c.y.	12.00	16.00	10.00
29. Granolothic finish	3,200 s.y.	1.50	1.50	1.50
30. Granite trim	850 c.y.	170.00	210.00	160.00
31. Brick facing masonry	265 c.y.	70.00	60.00	60.00
32. Brick backing masonry	1,750 c.y.	40.00	36.00	35.00
33. Conc. roof tiles	2,300 s.y.	15.00	13.00	14.00
34. Vit. pipes and conduits	3,200 l.f.	1.50	1.20	1.75
35. Dry rubble masonry and paving	1,400 c.y.	10.00	11.00	12.00
36. Rubble masonry and paving in mortar	550 c.y.	12.00	13.00	15.00
37 Crushed stone and gravel	200 c.y.	2.00	4.25	4.00
38. Bit. macadam pavement	100 s.y.	3.00	5.00	5.00
39. Conc. pavement	900 c.y.	10.00	11.00	10.00
40. Portland cement	495,000 bbl.	2.00	2.30	2.00
41. Reinf	1,050,000 lb.	.05	.063	.07
42. Struct. steel	1,500,000 lb.	.06	.075	.05
43. Steel sheet piling	6,300,000 lb.	.05	.058	.05

Time for completion: 70 months.

DREDGING, FLORIDA

OWNER: U. S. Engineers, Mobile office.

PROJECT: Removing material, including rock, from St. Marks River channel, Wakulla county, Fla. Length is 7,261 ft., and a channel depth of 10 ft. at mean low tide is to be provided. Bottom width is 100 ft. Contract also includes removal of an old masonry pier at St. Marks to a depth of 11 ft. below mean tide. Stipulated contract time is 100 days.

BIDS: Three bids were received Oct. 14, 1938, ranging from the contract low of $57,698 to $74,049. Minimum labor rates are as follows: skilled, 80c. per hr.; semi-skilled, 40c. per hr.; common, 35c. per hr.

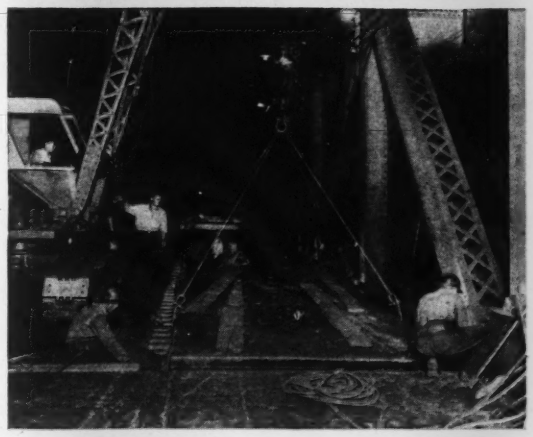
LOW BIDDERS:

1. The R. C. Huffman Construction Co., Buffalo, N. Y. (contract) $57,698
2. Shell Producers Co., Tampa, Fla. 68,708
3. Hill Dredging Co., Ventnor, N. J. 74,049

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Rock excav	17,210 c.y.	$2.51	$3.40	.....
2. Excav	48,820 c.y.	.29	.20	.....
3. Masonry removal	86 c.y.	4.00	5.00	.....
Flat rate — 3rd bidder	per c.y.	.....	.....	1.12

PRESTO! A NEW BRIDGE DECK

1 Grid-reinforced slabs each 9′ x 18′10″, 4″ thick, weight 6½ tons, were precast by Harris Structural Steel Co., New York, and came to job complete with steel stringers, ready to set on girders.



2 Below-deck steel was cut during the day; at night, the old wood-block floor was torn out and slabs set in place. 188,000 sq. ft. of roadway replaced without traffic tie-up.

3 New deck in use. Slabs were cast under strict control; specified 7-day strength, 4000 lb.; actual average, 4400 lb.

'INCOR' USED IN PRECAST CONCRETE SLABS FOR NEW YORK'S MANHATTAN BRIDGE

"PRESTO! A New Bridge Deck"—reads a newspaper headline, reflecting public appreciation at the speed and efficiency with which the old wood-block roadway of New York's Manhattan Bridge over the East River was replaced with grid-reinforced concrete slabs. The entire 35′ roadway, 6370′ long, was re-built in four months—without traffic delay.

Typical of sound engineering employed by the Department of Public Works of the City of New York in successfully achieving the threefold objective of increased public convenience, greater safety, and reduced maintenance costs.

Why 'Incor' Concrete Was Used

Based upon its 12-year record on highways and bridges—and especially on its performance under 103,000-car-a-day average traffic on New York's Queensboro Bridge, 'Incor' 24-Hour Cement was used for precast units on Manhattan Bridge.

'Incor' saves money through dependable high early strength and reduced curing time. That means better concrete at lower cost on many jobs. It pays to figure every job with both Lone Star and 'Incor'.* Then, let economy decide which cement to use. Write for copy of "Cutting Concrete Costs". Address Lone Star Cement Corporation, Room 2290, 342 Madison Avenue, New York, N. Y.

*Reg. U. S. Pat. Off.

LONE STAR CEMENT CORPORATION

MAKERS OF LONE STAR CEMENT . . . 'INCOR' 24-HOUR CEMENT

Bailey Meters AT BOULDER DAM

● In Boulder Dam Power Plant as in many other new hydro-electric stations including Madden Dam and Norris Dam, Bailey Fluid Meters are installed on hydraulic turbines.

At Boulder Canyon, the Bailey Meters measure water supply through 13 foot diameter penstocks under an average head of 530 feet. These meters indicate and record the water flow in terms of cubic feet per second and continuously integrate in millions of cubic feet. The registers are operated by pressure connections in the turbine scroll casings.

While your project probably does not entail the volume and head of water that is being measured at Boulder Canyon, it is nevertheless, important that your measurements of flow and liquid level be accurately made by reliable equipment.

Write for complete information on the application of Bailey Meters to your problem. MU-19

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1029 Ivanhoe Road, Cleveland, Ohio
BAILEY METER COMPANY LTD., MONTREAL

THE WEEK'S EVENTS

(Continued from page 8)

San Jacinto Workers Honored by Board

B. C. Leadbetter, general superintendent on the San Jacinto Tunnel of the Colorado River aqueduct, and his two chief assistants, C. E. Sides and S. J. Shrode, received official recognition Dec. 2 from the board of directors of the Metropolitan Water District of Southern California for their work on the tunnel. The 13-mile tunnel, last of 38 on the aqueduct, was holed through Nov. 19.

Leadbetter and his two superintendents were called before the regular meeting of the board and after letters expressing the thanks of the board had been approved and presented to the men, the board voted to strike off special service award medals for the men employed on the tunnel job.

"The San Jacinto tunnel working organization," the letter from the board said, "established itself as a tunnel construction force unsurpassed in the annals of engineering history."

The entire aqueduct system is scheduled to be ready for operation by the middle of 1939. More than 60 per cent of the distribution system is now completed, and work on the main line 392-mile aqueduct is nearly finished.

• • •

Trans-bay Traffic Triples After S. F. Bridge is Built

Two years operating experience on the San Francisco-Oakland Bay Bridge, shows total earnings of $9,480,514 with a daily average since the span opened of 24,388 vehicles. In the second year, transbay traffic was 300 per cent greater than in the last pre-bridge year.

In this second year traffic increases over the first year were: passenger automobiles, 0.27 per cent (low by reason of lower fare on ferries); buses, 30 per cent; trucks 48 per cent. In the two-year period the bridge tow service was used an average of 18.79 times per day; the bridge fire department put out 69 vehicle fires. Records show one accident for every 165,424 vehicles, or one injury per 360,531 persons using the bridge. The interurban electric railway service is scheduled to begin early in January.

• • •

Pennsylvania Builders Urge Higher Minimum Wage

The Pennsylvania highway department was urged to raise the minimum wage rates listed in bid calls to bring them into line with actually prevailing rates in a resolution adopted at the annual convention of the Associated Pennsylvania Constructors in Harrisburg Dec. 14-16. During the past year, it was said, contractors paid much higher wages than those stipulated in the state's proposal.

The wage proposal was part of a comprehensive legislative program which included a stand in favor of a constitutional amendment prohibiting diversion of highway taxes and a plan to push a qualification act under which contractors would have to be qualified in order to bid on state highway work.

The contractors urged amendment of the state arbitration act of 1937, which set up an impartial arbitration board to settle contractors' claims against the state; the act failed at that time to appropriate funds for the board's work, and the association is anxious to have the board set up.

The association is considering organization of a workmen's compensation insurance company if they are unable to obtain a satisfactory explanation of recent increases in compensation rates.

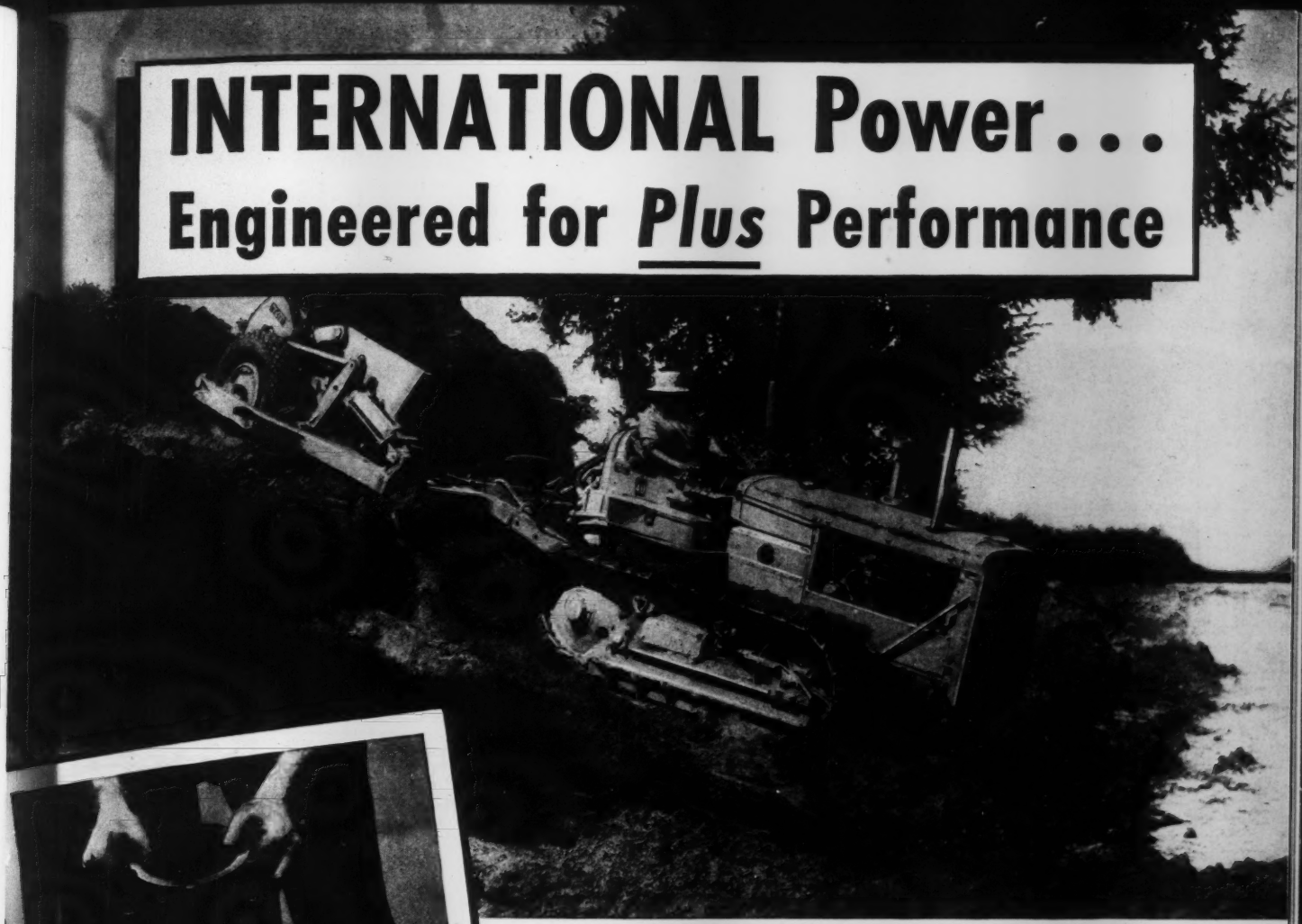
Incumbent officers were nominated by the nomination committee for reelection in April.

MEN AND JOBS

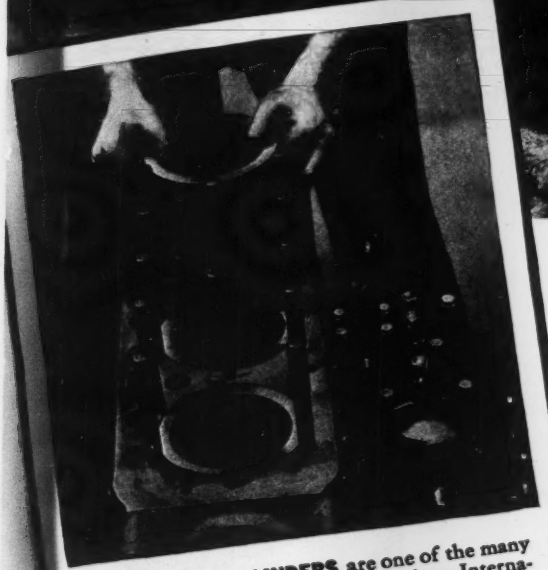
VICTOR K. GAMBLE has been appointed secretary and chief engineer of the Ohio Paving Brick Manufacturers Association, Ohio section of the National Paving Brick Association. Gamble has been assistant materials and testing engineer with the Ohio state highway department since 1931. He was educated at Ohio State University and before joining the highway department worked for the contracting firm of Fritz-Rumer-Cooke Co. and the Hocking Valley Ry.

CARL V. BERGSTROM, traffic engineer in the Milwaukee bureau of electrical service, has received a nine months leave of absence to serve as director

INTERNATIONAL Power...
Engineered for *Plus* Performance



International TracTracTors have a great reputation for their fast, flexible operation under tough conditions. This is the Model TD-40 Diesel doing its stuff on an earth-moving job.



REPLACEABLE CYLINDERS are one of the many money-saving features engineered into International Industrial Tractors and Power Units. Cylinders may be removed and replaced with new cylinders of the same size. These new cylinders, with new pistons, fully renew the original engine compression and efficiency. This feature saves International owners the cost of expensive reboring operations.

• There are many sound and practical reasons back of the wide preference for International Industrial Power. When you buy International you buy low-cost maintenance, long life, and performance and economy that produce profit on the job . . . the result of the skilled engineering that goes into every detail of International Harvester *quality* products. There are TracTracTors (crawlers) and wheel tractors for gasoline and Diesel operation, and 11 models of power units, gasoline, Diesel, and gas, ranging up to 110 max. h.p., in the International line. Check into these tractors and engines and see for yourself how they fit into your operations. The nearby International industrial power dealer or Company-owned branch will demonstrate the efficiency and economy of International Power any time you say.

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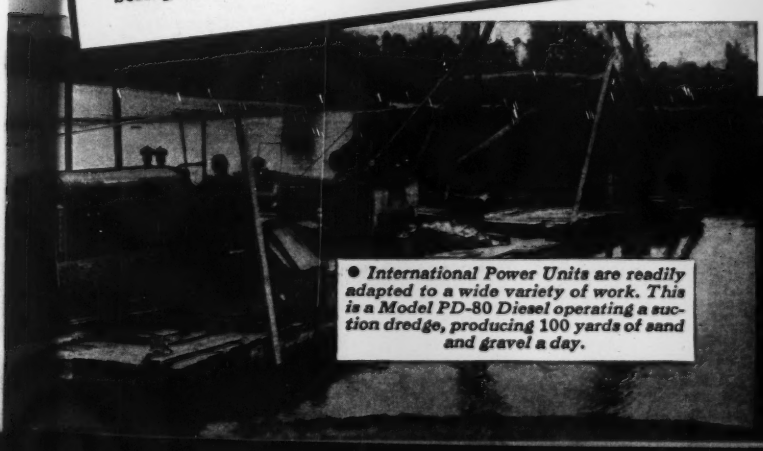
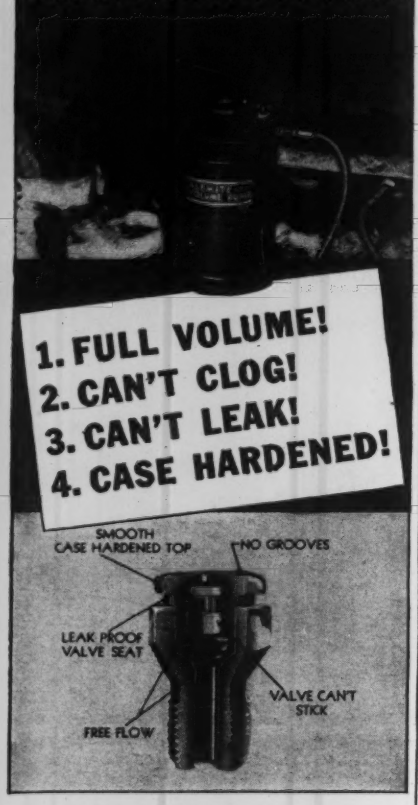


• *International Power Units are readily adapted to a wide variety of work. This is a Model PD-80 Diesel operating a suction dredge, producing 100 yards of sand and gravel a day.*

INTERNATIONAL INDUSTRIAL POWER

AMAZING NEW FREE FLOW FITTING



"FREE-FLOW"—that's the accurate way to describe this amazing new type Alemite Giant Button Head Fitting! It belongs on every heavy duty machine bearing *where a large volume of lubricant under pressure is required,* as on tractor track rolls.

With the newly designed valve plunger, little effort is needed to introduce a full FREE FLOW of lubricant—*no pressure is wasted in opening the fitting.* The valve plunger can't tip, and its bridge-shaped design assures FREE FLOW of lubricant through the slotted passage and down through the center of the spring.

Because the valve plunger must come to a positive stop at the bottom of the opening, there can be no over stressing, bending, or breaking of the spring. *THIS FITTING CAN'T JAM OR CLOG!* Valve plunger snaps back instantly to closed position as soon as pressure is released. And the top of the fitting is case hardened to withstand the punishment of heavy duty service—smooth to give coupling seal longer life without leakage.

Mail the coupon for complete information.

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WORLD'S LARGEST MANUFACTURER OF LUBRICATION PRODUCTS

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Please send complete facts about your new FREE-FLOW Alemite Giant Button Head Fitting.
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Firm Name.....

of a WPA survey of traffic conditions in the county.

ARTHUR D. SHAW has become a member of the Brooklyn, N. Y., civil engineering firm of Erlandsen & Crowell.

JOHN W. WOERMAN, principal engineer in the U. S. Engineer Office at Chicago, will retire on account of age Jan. 31. Woerman joined the federal service in 1890, immediately after his graduation from Washington University and except for a few years in private employment near the beginning of the century he has been in the government service since that time, almost entirely on midwestern rivers and on harbor work at the south end of Lake Michigan. He became senior engineer in the Chicago district in 1929 and principal engineer in 1936.

PHILLIP D. THURMOND has been appointed city engineer of Fulton, Mo.

JOHN W. COOK, JR., recently resigned his post as city engineer of Fulton to join the PWA staff.

J. D. LEVIN, construction engineer in the public building branch of the federal Procurement Division, has been transferred from his post in Illinois to Paulding, Ohio, where he will supervise construction of a new post office.

ERNEST A. WHITE has been appointed county engineer of Pierce County, Wash., effective Jan. 9. On that date, the office, previously elective, becomes an appointive position. White has been assistant county engineer, having been twice elected to that post.

BRIEF NEWS

REPORTING to the Buffalo Sewer Authority of Buffalo, N. Y., Samuel A. Greeley of the firm of Greeley & Hansen, has recommended construction of a comprehensive storm water relief system based on the 10-year frequency storm. The report is the first of the studies being made by the firm for the authority. The ten year storm at Buffalo is at the rate of 1.8 in. per hour for a period of 40 min. Cost of storm sewers, Greeley reported, to meet the 10 year storm would be 9 per cent more than that to meet the 5 year storm.

THE BUREAU of Yards and Docks of the Navy Department has received a low bid of $390,000 from the Winslow Marine Ry. & Shipbuilding Co. of Seattle for construction of what is said to be the largest caisson gate in the country; it will be used in a $4,000,000 graving dock under construction at the Puget Sound Navy Yard. The gate will be 147 ft. long, and will be 54 ft. high and

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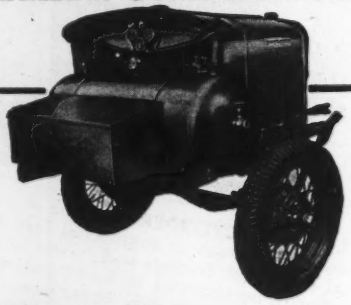

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27 ft. wide. This is 2 ft. lower but 34 ft. longer than the gates of the drydock at Balboa. It will be of steel construction with concrete ballast and a timber fender system; the upper deck will be surfaced with sheet asphalt.

CONSTRUCTION of the Valsequillo dam in Pueblo State has been begun by the Mexican government. The 260-ft. high structure is expected to cost about $5,000,000.

A BUILDING CONGRESS has been formed in Chicago comprising representatives of architectural, engineering, contracting, real estate, banking, labor, and building material and equipment interests. Elmer C. Jensen, president of the Illinois Society of Architects, was elected president of the Congress.

ANOTHER engineering firm, Hagey & Gray, of Canada has been retained by the Niagara Falls Bridge Commission as consultant in connection with the publicly owned bridge which the commission plans to build to replace the wrecked Falls View Bridge across the Niagara Gorge. The Canadian firm will cooperate with the American consultants previously employed by the commission (*ENR* Dec. 8, p. 715) to design and supervise the construction of the bridge.

A NEW CAUSEWAY has been opened connecting Galveston, Texas, with the mainland. The PWA-financed project was built at a cost of $2,500,000 by the Austin Bridge Co.; T. J. Kelley was supervising engineer at the time of completion. The last unit completed was a double leaf bascule bridge which was tested Nov. 28. Combined cost of the causeway, approaches, and overpasses will appropriate $4,000,000. The causeway will be formally dedicated next spring with completion of a railroad overpass at the north end.

G. LEROY KEMP, former land agent for the Connecticut state highway department, was sentenced to three to seven years in state penitentiary Dec. 16 after he had been found guilty of conspiring, in connection with land purchases for the Merritt Parkway, to divide commissions with two real estate brokers. It was as a result of the Grand Jury investigation in connection with Kemp's indictment that John A. Macdonald resigned last summer after 15 years as Connecticut highway commissioner.

WHEN the last two headings of the San Jacinto tunnel were holed through last month, the tunnel lines were found to be in exact alignment. The San Jacinto bore is 13 miles long, has been built under great difficulties, and has many angles in the alignment as well

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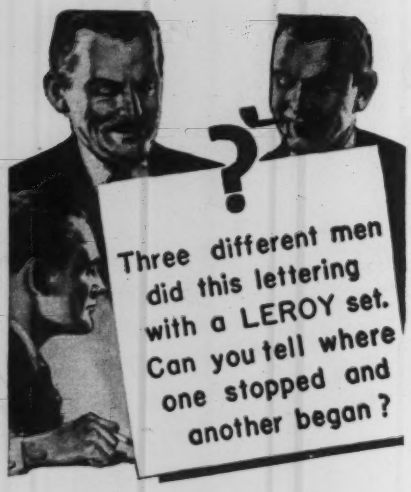

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as a detour near the Potrero shaft. Credit for the accurate check is given to W. E. Smith, assistant engineer in charge of underground surveys, and his two chiefs of party, R. H. Peyton and J. P. Patton.

After four attempts to fill the office of county road engineer of Warren County, Ky., resulted in tied votes, the county fiscal court abolished the position and named eight road agents for next year.

MEETINGS

NATIONAL SOCIETIES

Canadian Construction Association, annual convention, Winnipeg, Man., Jan. 10-12.

American Shore and Beach Preservation Association, annual meeting, Hotel Carlton, Washington, D. C., Jan. 11.

American Engineering Council, annual assembly and third forum, Mayflower Hotel, Washington, Jan. 12-14.

American Society of Civil Engineers, annual meeting, New York City, Jan. 18-20, 1939.

National Paving Brick Association, annual meeting, Deshler-Wallick Hotel, Columbus, Ohio, Feb. 1-3.

American Toll Bridge Association, annual convention, Coronado Hotel, St. Louis, Mo., Feb. 6-8.

American Concrete Contractors Association, National Concrete Masonry Association, Illinois Builders League; third annual concrete industries convention and exposition; Sherman Hotel, Chicago, Feb. 7–9.

Association of Highway Officials of North Atlantic States, annual convention, Hotel Pennsylvania, New York City, Feb. 15-17.

Engineering Institute of Canada, annual general and professional meeting, Chateau Laurier, Ottawa, Feb. 20–22.

Southwest Road Show and School, Coliseum, Wichita, Kan., Feb. 21–24.

The Asphalt Institute, twelfth national asphalt conference, Biltmore Hotel, Los Angeles, California, Feb. 27–March 3.

American Concrete Institute, annual convention, Roosevelt Hotel, New York City, Mar. 1-3.

American Society for Testing Materials, spring group meeting, Columbus, Ohio, Mar. 6-10.

REGIONAL AND LOCAL

Illinois Contractors Association, annual meeting, Faust Hotel, Rockford, Jan. 11–12.

New Jersey Association of Professional Engineers and Land Surveyors, annual convention, Robert Treat Hotel, Newark, New Jersey, Jan. 13–14.

University of Colorado, highway engineering conference Boulder, Jan. 19-20.

Illinois Society of Engineers, annual meeting, Elks Building, Springfield, Jan. 26-28.

North Carolina Society of Engineers, annual meeting, engineers institute, surveyors institute, and engineers week, Raleigh, Jan. 27-Feb. 1.

Bureau of Engineering Research and College of Engineering of the University of Texas, annual conference on foundations and soil mechanics, Austin, Feb. 3-4.

Louisiana Engineering Society, annual meeting, jointly with spring meeting of American Society of Mechanical Engineers, St. Charles Hotel, New Orleans, Feb. 23–25.

ELECTIONS AND ACTIVITIES

Frank Herrmann has been elected president of the Oklahoma section of the American Society of Civil Engineers. A. H. Riney is first vice president, D. H. Jones second vice president, and D. L. Wilson secretary-treasurer.

Fred H. Fowler is the new president of the San Francisco section of the Am. Soc. C. E. Other officers are: H. B. Hammill and J. I. Ballard, vice presidents; T. J. Corwin, secretary-treasurer.

Jerome P. Gebhard has been elected president of the Wisconsin section, Am. Soc. C. E., and Carl A. R. Distelhorst and Clarence A. Wilson have been elected vice presidents; Lloyd D. Knapp is the new secretary-treasurer.

Grover Estes has been reelected president of the Memphis chapter of the Associated General Contractors. Fred Sexton is vice president for 1939 and Fred Young secretary-treasurer.

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License Examinations

North Carolina: Semi-annual meeting of state board of architectural examination and registration at Washington-Duke Hotel, Durham, N. C., Jan. 15–19.